



SPECIFICATIONS

Satellite Bus Facility Remodel

Metro Transit Hanson Road

Madison, Wisconsin

Exhibit B

Contract #9086

Munis #10950

Engberg Anderson Project No. 213419.00

9/15/2023

305 W Washington Av | Madison, WI 53703 | (608) 250-0100 | www.engberganderson.com

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CIVIL

JSD PROFESSIONAL SERVICES, INC.
507 W VERONA AVE #500
VERONA, WI 53593
PH 608-848-5060



LANDSCAPE

JSD PROFESSIONAL SERVICES, INC.
507 W VERONA AVE #500
VERONA, WI 53593
PH 608-848-5060



ARCHITECT

ENGBERG ANDERSON, INC.
305 W WASHINGTON AVE
MADISON, WI 53703
PH 608-250-0100



STRUCTURAL

ONEIDA TOTAL INTEGRATED ENTERPRISES
1033 N MAYFAIR RD #200
MILWAUKEE, WI 53226
PH 414-257-4200



FIRE PROTECTION

THUNDERBIRD ENGINEERING, INC.
1651 JOHN Q HAMMONS DR #101
MIDDLETON, WI 53563
PH 608-820-1201



PLUMBING

THUNDERBIRD ENGINEERING, INC.
1651 JOHN Q HAMMONS DR #101
MIDDLETON, WI 53563
PH 608-820-1201



9/15/23

MECHANICAL

HEIN ENGINEERING GROUP
17 APPLGATE CT #200
MADISON, WI 53713
PH 608-288-9260



9/15/2023

ELECTRICAL

JDR ENGINEERING, INC.
5525 NOBEL DR #110
MADISON, WI 53711
PH 608-277-1728



9/15/2023

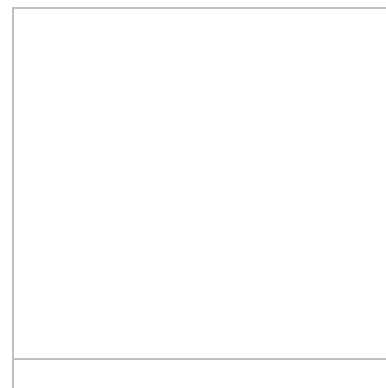
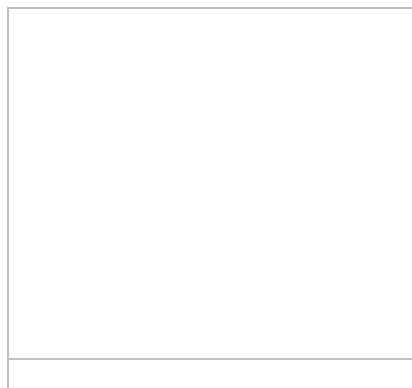
TELECOMMUNICATIONS

KMT DESIGN
581 CONCORD DRIVE
OREGON, WI 53575
PH 608-444-6067

MERTO TRANSIT HANSON ROAD SATELLITE BUS FACILITY REMODEL

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11 **PART 1 – GENERAL**

12
13 **1.1. SUMMARY**

- 14 A. Each project has varying requirements for permits, inspections, and fees based on the scope, size, and location of
15 the project.
16 B. The City of Madison (Owner) is subject to all permits, inspections and associated fees for construction,
17 demolition, utility connection, storm water management, and other similar requirements that may be required
18 to complete the scope of work associated with these contract documents.
19 C. The General Contractor (GC) shall be responsible for obtaining all permits, inspections and paying for all
20 associated fees unless specifically identified within this specification.
21

22 **1.2. REFERENCES**

- 23 A. The following references are not intended to be all inclusive. It shall be the GC’s responsibility to determine all
24 requirements based on the scope of work in the contract documents.
25 B. City of Madison Ordinances: Review all ordinances that may require a permit or fee that may be connected with
26 a required permit. Contact the following City Agencies to determine the exact requirements during bidding
27 1. Building Inspection
28 2. Zoning
29 3. Engineering
30 4. Water Utility
31 5. Traffic Engineering
32 6. Others as may be specified by the contract documents.
33 B. State Statutes
34 C. Other Regulatory Regulations
35 D. Other Agencies or companies that may have related requirements
36 1. Madison Metropolitan Sewerage District
37 2. Local gas and electric utility companies
38 3. Other utility companies
39

40 **1.3. GENERAL CONTRACTORS REQUIREMENTS**

- 41 A. The GC shall be responsible for all of the following:
42 1. Execute application for all required permits as may be required by the scope of work described within the
43 contract documents.
44 2. Paying all fees associated with the application of any required permits.
45 3. Scheduling all required inspections that may be conditions of any required permits.
46 C. The GC shall provide high quality scanned images of all required permits and inspections and upload them to the
47 Contract Documents-Regulatory Documents Library on the Project Management Web Site.
48

49 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

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51 **PART 3 – EXECUTION – THIS SECTION NOT USED**

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55 **END OF SECTION**
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SECTION 00 43 25
SUBSTITUTION REQUEST FORM (DURING BIDDING)

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14 **PART 1 – GENERAL**

15
16 **1.1. SUMMARY**

- 17 A. The City of Madison uses a specific list of preferred products for various specification items to establish
18 standards of quality, utility, and appearance required.
19 B. The City of Madison will not allow substitutions for specified Products except as follows:
20 1. The Product is no longer produced or the product manufacturer is no longer in business.
21 2. The manufacturer has significantly changed performance data, product dimensions, or other such design
22 criteria for the specified Product(s).
23 3. Products specified by naming one or more Products or manufacturer’s and “or approved equal” or
24 “approved equivalent.”
25 C. The procedures in this specification shall apply to all proposals by Contractors, Suppliers, Vendors, and
26 Manufacturers when the conditions in item 1.1.B. above have been met during the bidding phase.
27

28 **1.2. RELATED SPECIFICATIONS**

- 29 A. 01 25 13 Product Substitution Procedures
30

31 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

32
33 **PART 3 - EXECUTION**

34
35 **3.1. REQUESTING A SUBSTITUTION DURING BIDDING**

- 36 A. In the event that a substitution is requested during the bidding phase the Contractor, Supplier, Vendor, or
37 Manufacturer shall do all of the following:
38 1. Submit a Substitution Request Form for each different product. Use a printed/scanned copy of the form
39 at the end of this specification as a cover sheet.
40 2. Support your request with complete data, drawings, specifications, performance data and samples as
41 appropriate. A complete submission shall include the following:
42 a. Substitution Request Form as a cover sheet
43 b. Comparison of qualities of the proposed substitutions with that specified.
44 c. Changes required in other elements of the Work because of the substitution.
45 d. Effect on the construction schedule.
46 e. Cost data comparing the proposed substitution with the Product specified.
47 f. Any required license fees or royalties.
48 g. Availability of maintenance service and source of replacement materials.
49 3. Submit the Substitution Request Form and all required supporting documentation to the City Project
50 Manager and Project Architect.
51 a. Submissions to be done as complete PDF files for each product, appropriately titled
52 b. Email submissions to the Project Architect and City Project Manager at the email addresses
53 provided on the last page of Section D of the contract documents.
54 i. The subject line shall include the contract number and “Request for Substitution”.
55 Example: Contract 1234 – Request for Substitution
56 4. Submissions must be received by the substitution request deadline specified in Section A of the Contract
57 Documents.
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3.2. SUBMISSION REVIEW

- A. The Project Architect, City Project Manager, members of the design team, and the Owners staff shall review all submissions for substitutions during the bidding phase.

3.3. SUBSTITUTION APPROVAL

- A. All requests for substitutions that have been approved shall be published by Addenda to the bid documents.

NOTE SEE NEXT PAGE FOR SAMPLE SUBSTITUTION REQUEST FORM.

1
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3.4. SUBSTITUTION REQUEST FORM

For Pre-bid Substitution Requests all text boxes on this form are required information for a complete request.

	<h1>Substitution Request</h1>		
Today's Date:	<input type="text"/>		
Project Title:	<input type="text"/>		
Project Number:	<input type="text"/>	Contract Number:	<input type="text"/>
<p><i>By completing and submitting this form for review the General Contractor affirms that all of the following statements are correct:</i></p> <ol style="list-style-type: none"><i>The General Contractor affirms that this request is in compliance with the requirements described in Specification 01 25 13 Product Substitution Procedures.</i><i>The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.</i><i>The proposed substitution does not affect dimensions shown on the drawings.</i><i>The proposed substitution will have no adverse affects on other trades, the construction schedule, or any specified warranty requirements.</i><i>Maintenance and service parts will be locally available for the proposed substitution. (GC shall provide supporting documentation in the attachments section below.)</i><i>The General Contractor shall be responsible for any and all costs associated with this substitution request if approved. This includes but is not to limited to fees for building design, engineering design fees, detailing fees, plan review fees, construction costs, and inspection fees.</i>			
<p style="text-align: center;"><u>GC Substitution Request:</u></p>			
General Title:	<input type="text"/>		
Related Specification:	<input type="text"/> <input type="text"/> <input type="text"/>		
Reason for Substitution:	<input type="text"/>		
Proposed Substitution: <small>(include Name, Model, etc.)</small>	<input type="text"/>		
Submitted By:	<input type="text"/>	Phone:	<input type="text"/>
Company:	<input type="text"/>	Email:	<input type="text"/>

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**SECTION 00 43 43
WAGE RATES FORM**

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PART 1 – GENERAL

1.1. SUMMARY

- A. The Reimbursable Hourly Worksheet is a contractor provided document that indicates the basic rate of pay, fringe benefits, and each companies cost of required insurance for all Trades and Classifications that will be performing productive labor during the execution of this contract.
 - 1. Rates shall be similar to recognized rates published by the Bureau of Labor Statistics, Associated General Contractors (AGC), Associated Builders and Contractors (ABC), appropriate union contracts, and other similar organizations or documents.
- B. The Reimbursable Labor Rate Worksheet shall provide the basis for labor rates being used on Change Order Request forms.

1.2. RELATED SPECIFICATIONS

- A. Section 01 26 57 Change Order Request
- B. Section 01 29 76 Progress Payment Procedures
- C. Section 01 31 23 Project Management Web Site (Autodesk Construction Cloud)
- D. Section 01 32 19 Submittals Schedule

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1. GENERAL REQUIREMENTS

- A. Prior to the Pre-Construction Meeting the City Project Manager (CPM) or the City Construction Manager (CCM) shall provide the GC a copy of the *Reimbursable Labor Rate Worksheet.xls*.
 - 1. See the last page of this specification for an example of the worksheet.
- B. The GC shall provide all subcontractors that will be performing productive labor during the execution of this contract with additional copies of the worksheet as needed.
- C. All contractors shall be required to fill out and submit completed worksheets for all Trades and Classifications of labor that will be performing productive labor during the execution of this contract.

3.2. GENERAL CONTRACTORS RESPONSIBILITIES

- A. The GC shall consolidate all Trades and Classifications into one master Excel Workbook of all trades.
- B. The GC shall provide the combined workbook as required by Section 1.6 of Specification 01 32 19 Submittals Schedule for review and approval by the Owners Representatives.
 - 1. Submittal shall be an Exported PDF of the completed Excel Workbook.
 - a. As an Exported PDF the individual worksheets will be bookmarked and the document will be word searchable for easy reference.
- C. The GC shall only use the rates posted in the approved submittal throughout the execution of this contract.

1
 2

Reimbursable Hourly Rate Worksheet

(see bottom of page for instructions)

Project Name: _____
 Project Location: _____
 Project Number: _____
 Contractor: _____
 Rates are based on the following documentation: _____

Enter TRADE Here:

Carpenter

<u>Classification:</u>		<u>Foreman</u>	<u>Journeyman</u>	<u>Laborer</u>	<u>Apprt 1</u>	<u>Other</u>	<u>Other</u>	<u>Other</u>
Base Rate (BR)		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Vacation		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Health Insurance		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Pension		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Apprenticeship		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<i>Sub-total</i>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
BR Sub-total		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Work. Comp	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Gen Liability	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
WI Unemploy	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Fed Unemploy	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
FICA	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<i>Sub-total</i>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TOTAL COST		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Enter YOUR percentage of base rate in the column below.

0	- Work. Comp
0	- Gen Liability
0	- WI Unemploy
0.6	- Fed Unemploy
7.65	- FICA

Form Instructions:

1. Provide a work sheet for ALL Trade Classifications that will be performing on site productive labor during the execution of this project.
2. Responsible contractor to complete only boxes that are shaded, all non-shaded boxes are formula driven.
3. Contractor shall provide the name of the source used for these rates. (union contract, Bureau of Labor and Statistics, AGC, ABC, etc.) and be prepared to provide copies if so requested.

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END OF SECTION

**SECTION 00 62 76.13
SALES TAX FORM**

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PART 1 – GENERAL 1
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PART 2 – PRODUCTS – THIS SECTION NOT USED 1
PART 3 – EXECUTION – THIS SECTION NOT USED 1

PART 1 – GENERAL

1.1. SUMMARY

- A. The City of Madison is a qualifying tax exempt entity in the State of Wisconsin.
- B. The Contractor shall refer to *Section 102.9 – Bidders Understanding of the City of Madison Standard Specifications for Public Works Construction* for more information on Tax Exempt Status.
- C. This project constructs or remodels facilities owned by the City of Madison in Madison, Wisconsin.

1.2. RELATED SPECIFICATION SECTIONS

- A. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public Works Construction”.
 - 1. Use the following link to access the Standard Specifications web page:
<http://www.cityofmadison.com/business/pw/specs.cfm>
 - a. Click on the “Part” chapter identified in the specification text. For example if the specification says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II PDF will open.
 - b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.

1.3. TAX EXEMPT FORM

- A. The Contractor can access Wisconsin Sales and Use Tax Exemption Certificates (form S-211, Wisconsin Department of Revenue) from the City of Madison Finance website.
 - 1. City of Madison tax exempt information and signature by Purchasing Supervisor is already completed.
 - 2. Website: <http://www.cityofmadison.com/employeeenet/finance/purchasing>
 - a. Under the title *Purchasing Forms*, scroll down to the form link titled *Sales Tax Exempt Form S-211*.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

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SECTION 01 25 13
PRODUCT SUBSTITUTION PROCEDURES

1
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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 PART 2 – PRODUCTS..... 1
8 2.1. SUBSTITUTION REQUEST FORM..... 1
9 PART 3 - EXECUTION 1
10 3.1. REQUESTING A SUBSTITUTION DURING BIDDING..... 1
11 3.2. REQUESTING A SUBSTITUTION AFTER AWARD OF CONTRACT 2
12 3.3. UNAUTHORIZED SUBSTITUTIONS..... 2
13

PART 1 – GENERAL

1.1. SUMMARY

- 17 A. The City of Madison uses a specific list of preferred products for various specification items to establish
18 standards of quality, utility, and appearance required.
19 B. The City of Madison will not allow substitutions for specified Products except as follows:
20 1. The Product is no longer produced or the product manufacturer is no longer in business.
21 2. The manufacturer has significantly changed performance data, product dimensions, or other such design
22 criteria for the specified Product(s).
23 3. Products specified by naming one or more Products or manufacturer’s and “or approved equal” or
24 “approved equivalent.”
25 C. The City of Madison will not allow substitutions for specified Products as follows:
26 1. For Products specified by naming only one Product and manufacturer, no substitute product will be
27 considered.
28 2. For Products specified by naming several Products or manufacturers select any one of the products or
29 manufacturers named, which complies with the specifications. No substitute product will be considered.
30 D. Request for substitutions from any party other than the General Contractor (GC) will not be accepted.
31

1.2. RELATED SPECIFICATIONS

- 33 A. Section 01 26 13 Request for Information (RFI)
34 B. Section 01 31 23 Project Management Web Site
35 C. Section 01 33 23 Submittals
36

PART 2 – PRODUCTS

2.1. SUBSTITUTION REQUEST FORM

- 40 A. During bidding all contractors (General and Sub-contractors) and suppliers of materials or products shall provide
41 hard copy of the Substitution Request form and all required attachments directly to the Project Architect.
42 1. Contractors and suppliers shall use the screen shot of the form located at the end of this specification to
43 print a hard copy for all pre-bid substitution requests.
44 B. After bidding only the GC shall submit a request and shall use the form located on the Project Management Web
45 Site.
46

PART 3 - EXECUTION

3.1. REQUESTING A SUBSTITUTION DURING BIDDING

- 50 A. In the event that a substitution is requested during the bidding phase the Contractor or Supplier shall meet the
51 substitution request deadline listed in the bidding documents. No substitution request will be considered during
52 the bidding period after the stated substitution request deadline. In general this procedure shall be as follows:
53 1. Submit a Substitution Request Form for each different product
54 2. Support your request with complete data, drawings, specifications, performance data and samples as
55 appropriate. A complete submission shall include the following:
56 i. Substitution Request Form as a cover sheet
57 ii. Comparison of qualities of the proposed substitutions with that specified.
58 iii. Changes required in other elements of the Work because of the substitution.

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- iv. Effect on the construction schedule.
 - v. Cost data comparing the proposed substitution with the Product specified.
 - vi. Any required license fees or royalties.
 - vii. Availability of maintenance service and source of replacement materials.
- 3. Submit the Substitution Request Form and all required supporting documentation to the City Project Manager and Project Architect.
 - i. Submissions to be done as complete PDF files for each product, appropriately titled
 - ii. Email submissions to the Project Architect and City Project Manager at the email addresses provided on the last page of Section D of the contract documents.
 - iii. Submissions must be received by the substitution request deadline specified in Section A of the Contract Documents.
 - B. Substitutions submitted and approved during the bidding phase shall be announced by the City of Madison by addenda prior to the bid due date.
 - C. The Owner and Architect may reject any substitution request without providing specific reasons.

3.2. REQUESTING A SUBSTITUTION AFTER AWARD OF CONTRACT

- A. A substitution request will only be considered after award of contract if it meets the qualifying provisions as described in 1.1.B.1 and .2 above.
- B. The GC shall submit a substitution request using the digital form on the Project Management Web Site located in the Construction Administration-Substitution Request library.
 - 1. Click on *Add document* to open a new digital form, fill out form, provide required attachments, then click the Submit button.
 - 2. Consulting Staff, Owner and Owners Representatives will review the request and provide the appropriate approvals and feed back to the GC.

3.3. UNAUTHORIZED SUBSTITUTIONS

- A. Any Contractor who substitutes products without proper authorization by the Owner and Architect will be required to immediately remove and replace the product and all costs required to conform to the Contract Documents shall be borne by the General Prime Contractor.

NOTE SEE NEXT PAGE FOR SAMPLE SUBSTITUTION REQUEST FORM.

1

For Pre-bid Substitution Requests all text boxes on this form are required information for a complete request.

	<h1>Substitution Request</h1>
Today's Date:	<input type="text"/>
Project Title:	<input type="text"/>
Project Number:	<input type="text"/>
Contract Number:	<input type="text"/>
<p>By completing and submitting this form for review the General Contractor affirms that all of the following statements are correct:</p> <ol style="list-style-type: none">1 The General Contractor affirms that this request is in compliance with the requirements described in <i>Specification 01 25 13 Product Substitution Procedures</i>.2 The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.3 The proposed substitution does not affect dimensions shown on the drawings.4 The proposed substitution will have no adverse affects on other trades, the construction schedule, or any specified warranty requirements.5 Maintenance and service parts will be locally available for the proposed substitution. (GC shall provide supporting documentation in the attachments section below.)6 The General Contractor shall be responsible for any and all costs associated with this substitution request if approved. This includes but is not to limited to fees for building design, engineering design fees, detailing fees, plan review fees, construction costs, and inspection fees.	
GC Substitution Request:	
General Title:	<input type="text"/>
Related Specification:	<input type="text"/> <input type="text"/> <input type="text"/>
Reason for Substitution:	<input type="text"/>
Proposed Substitution: (include Name, Model, etc.)	<input type="text"/>
Submitted By:	<input type="text"/>
Company:	<input type="text"/>
Phone:	<input type="text"/>
Email:	<input type="text"/>

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**SECTION 01 26 13
REQUEST FOR INFORMATION (RFI)**

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6 1.2. RELATED SPECIFICATIONS 1
7 1.3. PERFORMANCE REQUIREMENTS..... 1
8 1.4. QUALITY ASSURANCE 1
9 PART 2 – PRODUCTS..... 1
10 2.1. REQUEST FOR INFORMATION FORM 1
11 PART 3 - EXECUTION 1
12 3.1. CONTRACTOR INITIATED RFI 2
13 3.3. RFI RESPONSES 2
14 3.4. COMMENCEMENT OF WORK RELATED TO AN RFI 2
15

PART 1 – GENERAL

1.1. SUMMARY

- 19 A. Contractors shall use the RFI form/process to request additional information or clarification regarding the
20 construction documents.
21 B. All RFI documentation will be processed through the through the Construction Administration-Request for
22 Information Library on the Project Management Web Site (PMWS).
23

1.2. RELATED SPECIFICATIONS

- 24 A. Section 01 26 46 Construction Bulletin (CB)
25 B. Section 01 26 57 Change Order Request (COR)
26 C. Section 01 26 63 Change Order (CO)
27 D. Section 01 31 23 Project Management Web Site (PMWS)
28 E. Section 01 91 00 Commissioning
29

1.3. PERFORMANCE REQUIREMENTS

- 30
31 A. RFI issues initiated by any contractor shall be done through the General Contractor (GC).
32 1. RFIs submitted by any Sub-contractor under the GCs control shall be returned with no response.
33 B. Submit a new RFI for each issue. Only multiple questions that are of a similar nature may be combined into one
34 RFI shall be allowed and responded to.
35
36

1.4. QUALITY ASSURANCE

- 37 A. The GC shall be responsible for all of the following:
38 1. Ensure that any request for additional information is valid and the information being requested is not
39 addressed in the construction documents.
40 2. Ensure that all requests are clearly stated and the RFI form is completely filled out.
41 3. Ensure that all Work associated an RFI response is carried out as intended.
42 B. The Project Architect (PA)/Project Engineer (PE) shall be responsible for the following:
43 1. Ensure that all responses to contractor initiated RFIs are properly responded to in a timely fashion.
44 a. The CPM, Owner, consulting staff, and other City staff shall be responsible for the initial review of
45 the RFI. The PA shall be responsible for codifying all consultant and Owner/City staff comments
46 into a unified RFI response.
47
48

PART 2 – PRODUCTS

2.1. REQUEST FOR INFORMATION FORM

- 49
50
51 A. The RFI form is located on the Project Management Web Site. The GC, PA/PE, or CPM as appropriate shall click
52 the link in the left margin of the project web site opening a new form. Project information is pre-loaded, provide
53 additional information as indicated below in the execution to complete the form.
54
55

PART 3 - EXECUTION

1 **3.1. CONTRACTOR INITIATED RFI**

- 2 A. Immediately on discovery of the need for additional information or interpretation of the Contract Documents
3 any contractor may initiate an RFI for additional information or clarification through the GC.
4 B. The GC shall select the "Submit an RFI" link on the Project Management Web Site and completely fill out the
5 form as follows:
6 1. Contract related information will be automatically populated on the form.
7 2. Thoroughly explain the issue at hand, provide backup information (photographs, sketches, drawings,
8 data, etc) as necessary, and clearly state the question or problem that requires a resolution. Combine
9 like or related issues but do not include multiple issues on one form.
10 a. Example. If a duct interferes with other critical piping and electrical work include all issues into
11 one RFI.
12 b. Example. If you have a question regarding the chiller and another regarding toilet partitions
13 create separate RFIs.
14 3. Check all relevant boxes for trades affected. This will assist the design team in determining who should
15 be reviewing the RFI.
16 C. Upon completing the RFI click the "Submit" button. The PMWS software will automatically route the RFI to the
17 appropriate reviewers.
18

19 **3.3. RFI RESPONSES**

- 20 A. Responses to simple RFI issues shall use the response section of the RFI form and shall be completed within five
21 (5) working days of the RFI form being submitted.
22 B. Responses to more complex issues may require additional time or may require a Construction Bulletin to be
23 published. The initial RFI shall be responded to within five (5) working days stating that the RFI is being
24 reviewed and provide an estimated date for the response.
25 C. The following GC generated RFIs will be returned without action:
26 1. Requests for approval of submittals
27 2. Requests for approval of substitutions
28 3. Requests for approval of Contractor's means and methods.
29 4. Requests for coordination information already indicated in the Contract Documents.
30 5. Requests for adjustments in the Contract Time or the Contract Sum.
31 6. Requests for interpretation of A/E's actions on submittals.
32 7. Incomplete RFI or inaccurately prepared RFI.
33

34 **3.4. COMMENCEMENT OF WORK RELATED TO AN RFI**

- 35 A. The GC shall only proceed with the Work of an RFI when additional information is not required.
36 B. The GC shall not proceed with any Work associated with an RFI while it is under review.
37 C. The GC shall not proceed with any Work associated with an RFI that clearly states a CB will be issued in response
38 to the RFI.
39 D. The GC will be required to immediately remove and replace unauthorized Work and all costs required to
40 conform to the Contract Documents shall be borne by the GC.
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43

44 **END OF SECTION**
45
46

**SECTION 01 26 46
CONSTRUCTION BULLETIN (CB)**

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6 1.2. RELATED SPECIFICATIONS 1
7 1.3. PERFORMANCE REQUIREMENTS..... 1
8 1.4. QUALITY ASSURANCE 2
9 PART 2 – PRODUCTS..... 2
10 2.1. CONSTRUCTION BULLETIN FORM 2
11 PART 3 - EXECUTION 2
12 3.1. WRITING THE CONSTRUCTION BULLETIN 2
13 3.2. EXECUTING THE CONSTRUCTION BULLETIN..... 2
14

PART 1 – GENERAL

1.1. SUMMARY

- 18 A. Construction Bulletins (CB) are formal published construction documents that modify the original contract bid
19 documents after construction has commenced. CBs may be published for many reasons, including but not
20 limited to the following:
21 1. Clarification of existing construction documents including specifications, plans, and details
22 2. Change in product or equipment
23 3. A response to a Request for Information
24 4. Change in scope of the contract as either an add or a deduct of work
25 B. CBs provide a higher degree of detail in response to a Request for Information (RFI) through directives, revised
26 plans/details, and specifications as necessary.
27 C. The CB may change the original contract documents through additions or deletions to the Work.
28 D. Where the directives of a CB are significant enough to warrant a Change Order Request (COR) the GC shall use all
29 information provided in the CB to assemble all required back-up documentation for additions and deletions of
30 materials, labor and other related contract costs for the COR.
31 E. All CB documentation will be processed through the Construction Administration-Construction Bulletin Library
32 on the Project Management Web Site (PMWS).
33

1.2. RELATED SPECIFICATIONS

- 34 A. Section 01 26 13 Request for Information (RFI)
35 B. Section 01 26 57 Change Order Request (COR)
36 C. Section 01 26 63 Change Order (CO)
37 D. Section 01 31 23 Project Management Web Site
38 E. Section 01 91 00 Commissioning
39
40

1.3. PERFORMANCE REQUIREMENTS

- 41 A. Project Architect (PA)/Project Engineer (PE): The PA/PE shall be the only person authorized to publish a CB as
42 needed for any reason indicated in section 1.1.A above. The PA/PE shall consult as necessary with any of the
43 following while drafting the CB and shall confirm final direction with the CPM prior to issuing a CB:
44 1. City Project manager (CPM)
45 2. Owner
46 3. Members of the consulting staff
47 4. Members of city staff
48 5. The General Contractor
49 6. Sub-contractors
50 7. Commissioning Agent (CxA)
51 B. General Contractor: The GC shall be responsible for the following as needed:
52 1. Executing the directives of the CB when they believes that no changes in labor, materials, equipment, or
53 contract duration will be required for additions or deletions.
54 2. Submit a COR when they believes that a change in labor, materials, equipment or contract duration will
55 be required for additions or deletions.
56
57

1 **1.4. QUALITY ASSURANCE**

- 2 A. The PA/PE shall be responsible for ensuring the final CB sufficiently provides direction, details, specifications and
3 other information as necessary for the GC to perform the intended Work.
4 B. The PA/PE shall be responsible for ensuring the final CB is published as expeditiously as practical based on the
5 complexity of the CB being written. CBs that may affect the GC critical path shall be given priority.
6

7 **PART 2 – PRODUCTS**

8
9 **2.1. CONSTRUCTION BULLETIN FORM**

- 10 A. The CB form is located on the Project Management Web Site. The PA/PE shall click the link in the left margin of
11 the project web site opening a new form. Project information is pre-loaded, the PA/PE only needs to enter
12 information and make attachments as needed to complete the form.
13

14 **PART 3 - EXECUTION**

15
16 **3.1. WRITING THE CONSTRUCTION BULLETIN**

- 17 A. The PA/PE shall draft a CB as needed using the Construction Bulletin form on the Project Management Web Site.
18 1. The PA/PE and/or consulting staff as necessary shall provide specifications, model numbers and
19 performance data, details and other such information necessary to clearly state the intentions of the CB.
20 2. The consulting staff, CPM, Owner, CxA and other City Staff shall review the draft and recommend
21 changes as needed.
22 3. The PA/PE shall amend the draft as necessary into a final CB for review
23 B. Once the final CB has been approved the PA/PE shall “Submit” the CB through the Project Management Web Site
24 to the GC.
25

26 **3.2. EXECUTING THE CONSTRUCTION BULLETIN**

- 27 A. The GC shall acknowledge receipt of the CB on the Project Management Web Site as instructed in the Tutorial
28 Manual provided to the awarded contractor.
29 B. The GC shall notify all Sub-contractors of the CB and publish the CB to all field sets of drawings and specifications
30 as appropriate.
31 C. The GC shall execute the directives of the CB or submit COR documentation as necessary during the execution
32 and implementation of the CB.
33 1. See Specification 01 26 57 Change Order Request (COR)
34
35

36
37 **END OF SECTION**
38

**SECTION 01 26 57
CHANGE ORDER REQUESTS (COR)**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
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8 1.4. CONTRACT EXTENSION 3
9 1.5. OVERHEAD AND PROFIT MARKUP 3
10 1.6. PERFORMANCE REQUIREMENTS 3
11 1.7. QUALITY ASSURANCE 4
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13 2.1. CHANGE ORDER REQUEST FORM 4
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15 3.1. ESTABLISHING A CHANGE ORDER REQUEST 4
16 3.2. SUBMIT A CHANGE ORDER REQUEST FORM 4
17 3.3. CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING 5
18 3.4. EMERGENCY CHANGE ORDER REQUEST 5

PART 1 – GENERAL

1.1. SUMMARY

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22
23 A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made
24 by the General Contractor (GC) without having prior approval of the City Engineer or their representative.
25 B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in
26 the Work by written Change Order (CO). Such changes may include additions and/or deletions.
27 C. Where the City desires to make changes in the Work through use of written Change Order Request (COR), the
28 following procedures apply:
29 1. If requested by the City, the GC shall prepare and submit a detailed proposal, including all cost and time
30 adjustments to which the GC believes it will be entitled if the change proposed is incorporated into the
31 Contract. The City shall be under no legal obligation to issue a Change Order for such proposal.
32 2. The parties shall attempt in good faith to reach agreement on the adjustments needed to the Contract to
33 properly incorporate the proposed change(s) into the Work. In the event that the parties agree on such
34 adjustments, the City may issue a Change Order and incorporate such changes and agreed to
35 adjustments, if any.
36 3. In some instances, it may be necessary for the City to authorize Work or direct changes in Work for which
37 no final and binding agreement has been reached and for which unit prices are not applicable. In such
38 cases the following shall apply.
39 a. Upon written request by the City, the GC shall perform proposed Work
40 b. The cost of such change may be determined in accordance with this specification.
41 c. In the event agreement cannot be accomplished as contemplated herein, the City may authorize
42 the Work to be performed by City forces or to hire others to complete the Work. Such action on
43 the part of the City shall not be the basis of a claim by the GC for failure to allow it to perform the
44 changed Work.
45 D. Where changes in the Work are made by the City through use of a force account basis, the GC shall as soon as
46 practicable, and in no case later than ten (10) working days from the receipt of such order, unless another time
47 period has been agreed to by both parties, give the City written Notice, stating:
48 1. The date, circumstances and source of the extra work; and,
49 2. The cost of performing extra work described by such Order, if any; and,
50 3. Effect of the order on the required completion date of the Project, if any.
51 E. The giving of each Notice by the GC as prescribed by this specification, shall be a requirement to liability of the
52 City for payment of any additional costs incurred by the GC in implementing changes in the Work. Under this
53 specification, no order or statement of the City shall be treated as a Change Order, or shall entitle the GC to an
54 equitable adjustment of the terms of this Contract or damages for costs incurred by the GC on any activity for
55 which the Notice was not given.
56 F. In the event Work is required due to an emergency as described in this specification the GC must request an
57 equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the
58 commencement of such emergency.

- 1 G. All GC requests for equitable adjustment shall be submitted to the CPM per the specifications below. Such
- 2 requests shall set forth with specificity the amount of and reason(s) for the proposed adjustment and shall be
- 3 accompanied by supporting information and documents.
- 4 H. No adjustment of any kind shall be made to this Contract, if asserted by the GC for the first time, after the date
- 5 of final payment.
- 6 I. This specification shall be used by the GC when preparing documentation for any COR to ensure each has been
- 7 properly and completely filled out as required by the City of Madison.
- 8 J. All COR documentation will be processed through the Construction Administration-Change Order Request
- 9 Library on the Project Management Web Site (PMWS).

10
11 **1.2. RELATED SPECIFICATION SECTIONS**

- 12 A. Section 01 26 13 Request for Information (RFI)
- 13 B. Section 01 26 46 Construction Bulletins (CB)
- 14 C. Section 01 26 63 Change Order (CO)
- 15 D. Section 01 31 23 Project Management Web Site
- 16 E. Section 01 91 00 Commissioning
- 17 F. Parts of this specification will reference articles within "The City of Madison Standard Specifications for Public
- 18 Works Construction".
 - 19 1. Use the following link to access the Standard Specifications web page:
 - 20 <http://www.cityofmadison.com/business/pw/specs.cfm>
 - 21 a. Click on the "Part" chapter identified in the specification text. For example if the specification
 - 22 says "Refer to City of Madison Standard Specification 210.2" click the link for Part II, the Part II
 - 23 PDF will open.
 - 24 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
 - 25 to the referenced text.

26
27 **1.3. DEFINITIONS AND STANDARDS**

- 28 A. LABOR: The amount of time and cost associated with the performance of human effort for a defined scope of
- 29 Work. Labor is further defined as follows:
 - 30 1. Labor rate is the total hourly rate which includes the basic rate of pay, fringe benefits plus each
 - 31 company's cost of required insurance, also referred to as a reimbursable labor rate.
 - 32 2. Unit labor is the labor hours anticipated to install the corresponding unit of material.
 - 33 3. Labor cost is the labor hours multiplied by the hourly labor rates.
- 34 B. MATERIAL: Actual material cost is the amount paid, or to be paid, by the GC for materials, supplies and
- 35 equipment entering permanently into the Work, including cost of transportation and applicable taxes. The cost
- 36 shall not exceed the usual and customary cost for such items available in the geographical area of the project
- 37 C. LARGE TOOLS AND MAJOR EQUIPMENT: Large tools and major equipment are those with an initial cost greater
- 38 than \$1,500, whether from the GC or other sources.
 - 39 1. Tool and equipment use and time allowed is only for extra work associated with change orders.
 - 40 a. Rental Rate is the machine cost associated with operating a piece of equipment for a defined
 - 41 length of time (hour, day, week, or month) and shall not exceed the usual and customary amount
 - 42 for such items available in the geographical area of the project.
 - 43 b. Rental cost is the rental rate multiplied by the anticipated duration the equipment shall be
 - 44 required.
 - 45 2. The GC shall provide a breakdown of all rental rates to indicate what items and costs are associated with
 - 46 the rate. Examples of items to include in the breakdown would be fuel consumption, lubrication,
 - 47 maintenance and other similar expenses but not including profit and overhead.
 - 48 3. When large tools and equipment needed for Change Order work are not already at the job site, the
 - 49 actual cost to get the item there is also reimbursable.
- 50 D. BOND COST: The cost shall be calculated at 1% of the total proposed change order.
- 51 E. SUB-CONTRACTOR COSTS: Sub-contractor costs are for those labor, material, and equipment costs required by
- 52 subcontracted specialties to complete the Change Order work.
- 53 F. OVERHEAD AND PROFIT Markup: The allowable markup percentage to a COR by the GC and Sub-contractors for
- 54 overhead and profit. All of the following are expenses associated with overhead and profit and shall not be
- 55 reimbursable as individual items on any COR:
 - 56 1. CHANGE ORDER PREPARATION: All costs associated with the preparing and processing of the change
 - 57 order.

- 1 2. DESIGN, ESTIMATING, AND SUPERVISION: All such efforts, unless specifically requested by Owner as
- 2 additional Work to be documented as a COR or portion thereof.
- 3 3. INSTALLATION LAYOUT: The layout required for the installation of material and equipment, and the
- 4 installation design, is the responsibility of the GC.
- 5 4. SMALL TOOLS AND SUPPLIES: The cost of small hand tools with an initial cost of \$1,500 or less, along
- 6 with consumable supplies and expendable items such as drill bits, saw blades, gasoline, lubricating or
- 7 cutting oil, and similar items.
- 8 5. GENERAL EXPENSE: The general expense, which is those items that are a specific job cost not associated
- 9 with direct labor and material such as job trailers, foreman truck, and similar items.
- 10 6. RECORD DRAWINGS: The preparation of record or as-built drawings.
- 11 7. OTHER COSTS: Any miscellaneous cost not directly assessable to the execution of the Change Order
- 12 including but not limited to the following:
- 13 a. All association dues, assessments, and similar items.
- 14 b. All education, training, and similar items.
- 15 c. All drafting and/or engineering, unless specifically requested by Owner as additional Work to be
- 16 documented as a Change Order proposal or portion thereof.
- 17 d. All other items including but not limited to review, coordination, estimating and expediting, field
- 18 and office supervision, administrative work, etc.
- 19 G. Contract Extension: The necessary amount of time to be added to the contract deadlines for the completion of a
- 20 change order.
- 21

22 **1.4. CONTRACT EXTENSION**

- 23 A. The GC shall not assume that every COR will require a Contract Extension. If the GC feels a contract extension is
- 24 warranted they shall provide sufficient scheduling information that shows how the COR being requested impacts
- 25 the critical path of the project.
- 26 B. The City of Madison strongly encourages the GC to explore alternative methods and practices prior to submitting
- 27 a COR with a request for contract extension.
- 28

29 **1.5. OVERHEAD AND PROFIT MARKUP**

- 30 A. Pursuant to the City of Madison Standard Specifications for Public Works Construction, Section 104.7, Extra
- 31 Work, the following maximum allowable markups shall be strictly enforced on all change orders associated with
- 32 the execution of this contract.
- 33 1. The total maximum overhead and profit shall not exceed fifteen percent (15%) of the total costs.
- 34 2. The total maximum overhead and profit shall be distributed as follows:
- 35 a. For work performed and materials provided solely by the General Contractor, fifteen percent
- 36 (15%) of the total costs.
- 37 b. For work performed and materials provided solely by Sub-contractors and supervised by the
- 38 General Contractor:
- 39 i. Supervision of the GC, five percent (5%) of the total Sub-contractor cost.
- 40 ii. Sub-contractors work and materials ten percent (10%) of the total Sub-contractor cost.
- 41

42 **1.6. PERFORMANCE REQUIREMENTS**

- 43 A. The GC shall become thoroughly familiar with this specification as it will identify procedures and expenses that
- 44 are or are not allowed under the Change Order and Change Order Request process.
- 45 B. The GC shall be responsible for all of the following:
- 46 1. Carefully reviewing the CB that is associated with the COR.
- 47 2. Collecting required supporting documentation from all contractors that quantify the need for a COR.
- 48 a. Labor hours and wage rates
- 49 b. Material costs
- 50 c. Equipment costs
- 51 C. The following shall apply to establishing prices for labor, materials, and equipment costs:
- 52 1. Where Work to be completed has previously been established by individual bid items in the contract bid
- 53 proposal the GC shall use the unit bid prices previously established.
- 54 2. Where Work to be completed was bid as a Lump Sum without individual bid items the GC shall provide a
- 55 breakdown of all labor, materials, equipment including unit rates and quantities required.
- 56 D. The completion date is determined by Owner. The schedule, however, is the responsibility of the GC. Time
- 57 extensions for extra Work will be considered when a schedule analysis of the critical path shows that the Change
- 58 Order Request places the Work beyond the completion date stated in the Contract.

1
2 **1.7. QUALITY ASSURANCE**

- 3 A. The GC shall be responsible for ensuring that all COR supporting documentation meets the following
4 requirements prior to completing the COR form on the Project Management Web Site:
5 1. Sufficiently indicates labor, material, and other expenses related to completing the intent of the CB.
6 2. No costs exceed the usual and customary amount for such items available in the geographical area of the
7 project, and no costs exceed those established under the contract.
8 B. The Project Architect (PA)/Project Engineer (PE), Commissioning Agent (CxA), City Project Manager (CPM), other
9 members of the consulting staff, and city staff shall review all COR requests to ensure that the intent of the CB
10 will be met under the proposal of the COR or request additional information as necessary.
11

12 **PART 2 – PRODUCTS**

13
14 **2.1. CHANGE ORDER REQUEST FORM**

- 15 A. The COR form is located on the Project Management Web Site. The GC shall click the link in the left margin of
16 the project web site opening a new form. Follow additional instructions below in the execution section for filling
17 out the form.
18

19 **PART 3 - EXECUTION**

20
21 **3.1. ESTABLISHING A CHANGE ORDER REQUEST**

- 22 A. Upon receipt of a Construction Bulletin (CB) where the GC believes a significant change in contract scope
23 warrants the submittal of a COR the GC shall do all of the following within ten (10) working days after receipt of
24 the CB:
25 1. Review the CB with all necessary trades and sub-contractors required by the change in scope.
26 a. Additions or deletions to the contract scope shall be as directed within the CB.
27 b. Additions or deletions of labor and materials shall be determined by the GC based on the
28 directives of the CB.
29 2. Assemble all required back-up documentation for additions and deletions of materials, labor and other
30 related contract costs as previously outlined in this specification.
31 3. Submit a COR request form on the Project Management Web Site.
32 B. Submitting a COR does not obligate the GC to complete the work associated with the COR nor does it obligate
33 the Owner to approve the COR as a change to the contract.
34

35 **3.2. SUBMIT A CHANGE ORDER REQUEST FORM**

- 36 A. This specification shall provide a subject overview only. In depth instructions shall be provided to the awarded
37 Contractor in a PDF Instructional Manual.
38 B. The GC shall select the "Submit a COR" link on the Project Management Web Site.
39 C. The software will open a new COR form and the GC shall provide all of the following information:
40 1. DO NOT perform any calculations on this worksheet, only provide the raw data as requested below. All
41 calculations, totals, and markups shall be computed as described within this specification.
42 2. Provide a summary description of the COR request, and justification for any requested time extension to
43 the contract, indicate the number of calendar days being requested for the extension and add any
44 attachments to the form as needed.
45 3. Provide all GC self performance data including all of the following:
46 a. Materials description, quantities, and unit costs.
47 b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
48 c. Equipment descriptions, quantities, unit costs and rates.
49 4. Provide all Sub-contractor data including all of the following:
50 a. Materials description, quantities, and unit costs.
51 b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
52 c. Equipment descriptions, quantities, unit costs and rates.
53 5. Ensure all calculations performed by the form have been completed correctly. Contact the CPM directly
54 if you suspect an error before hitting the save button.
55 C. At any time after creating a COR you must at a minimum click "Save as Draft" to save your work.
56 D. When all data has been entered and verified click on the "Submit COR" button. This will kick off the COR Review
57 and Approval process.
58

1 **3.3. CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING**

- 2 A. The PA/PE and CPM shall review all CORs submitted by the GC.
- 3 1. Additional consulting staff and city staff having knowledge of the components of the COR shall review
- 4 and advise the PA/PE and CPM as to the accuracy of the items, quantities, and associated costs of the
- 5 COR as directed by the CB.
- 6 2. The CPM shall review the COR with the Owner.
- 7 B. If required the PA/PE and CPM, shall in good faith, further negotiate the COR with the GC as necessary. All
- 8 amendments to any COR shall be documented within the Project Management Web Site software.
- 9 C. After final review of the COR the CPM and Owner may accept the COR.
- 10 D. The CPM shall prepare the COR in the form of an official Board of Public Works Change Order for final review and
- 11 approval as outlined in Section 01 26 63 Change Order (CO).
- 12 E. The GC shall not act upon any accepted COR until it has received final approval through the Public Works process
- 13 as an official CO to the Work unless instructed to do so by the CPM. Proceeding without the final approval of a
- 14 fully authorized Change Order is at the GC's own risk.
- 15

16 **3.4. EMERGENCY CHANGE ORDER REQUEST**

- 17 A. In the event Work is required due to an emergency as described in the Contract Documents, the GC must
- 18 request an equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the
- 19 commencement of such emergency.
- 20 B. The GC shall provide full documentation of all labor, materials and equipment used during the period of
- 21 emergency as part of the COR submittal.
- 22
- 23
- 24

25 **END OF SECTION**

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**SECTION 01 26 63
CHANGE ORDER (CO)**

1
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3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. BOARD OF PUBLIC WORKS PROCEDURE 1
8 PART 2 – PRODUCTS..... 2
9 2.1. CHANGE ORDER FORM..... 2
10 PART 3 - EXECUTION 2
11 3.1. PREPARATION OF THE CHANGE ORDER 2
12 3.2. EXECUTION OF THE CHANGE ORDER 2
13

PART 1 – GENERAL

1.1. SUMMARY

- 17 A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made
18 by the General Contractor (GC) without having prior approval of the City Project Manager (CPM).
19 B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in
20 the Work by written Change Order. Such changes may include additions and/or deletions.
21 C. The Change Order (CO) is a Board of Public Works (BPW) form that is reviewed and approved by a specific
22 process.
23 D. The CO form is typically made up of multiple Change Order Requests (CORs) and/or Bid Items as appropriate
24 depending on the type of project and how the contract was bid.
25 E. All CO documentation shall be processed through the Construction Administration-Change Order Library and
26 digital workflow on the Project Management Web Site (PMWS).
27

1.2. RELATED SPECIFICATION SECTIONS

- 28
29 A. Section 01 26 13 Request for Information (RFI)
30 B. Section 01 26 46 Construction Bulletin (CB)
31 C. Section 01 26 63 Change Order Request (COR)
32 D. Section 01 31 23 Project Management Web Site
33 E. Section 01 91 00 Commissioning
34

1.3. BOARD OF PUBLIC WORKS PROCEDURE

- 35
36 A. The Board of Public Works has a very explicit procedure for the review and approval of all change orders
37 associated with any Public Works Contract as follows:
38 1. The Supervisory Chain of the CPM shall review and approve any CO under \$20,000 provided it does not
39 include either of the following:
40 a. The CO does not request a time extension to the contract.
41 b. The CO does not cause the contract contingency sum to be exceeded.
42 2. The Board of Public Works shall review and approve any CO that requires any of the following:
43 a. Any CO over \$20,000.
44 b. Any CO requesting a time extension to the contract regardless of the monetary value of the CO.
45 c. Any CO that that causes the contract contingency sum to be exceeded.
46 B. The Board of Public Works generally meets every other week and only once in August and December. The GC is
47 cautioned that, under normal scheduling, a CO requiring a BPW review will take a minimum of two (2) weeks to
48 achieve final approval.
49 1. The City shall not be responsible for additional delays to the Work caused by the scheduling constraints
50 of the Board of Public Works.
51 C. **SPECIAL NOTE:** The GC is cautioned to never proceed unless told to do so by the CPM. Only in rare instances
52 may the CPM give a written notice to proceed on a COR without an approved CO. Proceeding without the
53 written notice of the CPM or an approved CO is at the GC’s own risk.
54

1 **PART 2 – PRODUCTS**

2
3 **2.1. CHANGE ORDER FORM**

- 4 A. The CO form is located on the Project Management Web Site. The CPM shall click the link in the left margin of
5 the project web site opening a new form. Project information is pre-loaded, the CPM only needs to enter
6 information and make attachments as needed to complete the form.
7

8 **PART 3 - EXECUTION**

9
10 **3.1. PREPARATION OF THE CHANGE ORDER**

- 11 A. The CPM shall prepare the required CO forms in the Construction Administration-Change Order Library on the
12 Project Management Web Site as follows:
13 1. Provide information for all contract information.
14 2. Provide a general description of the items described within the change order.
15 3. Provide detailed information for each Item on the CO form. At the option of the CPM, they may include
16 multiple Change Order Requests each as their own item.
17 4. Provide required pricing and accounting information as needed for the item.
18 5. Insert attachments of contractor/architect provided information that clarifies and quantifies the CO.
19 Attachments may include but not be limited to material lists, estimated labor, revised details or
20 specifications, and other documents that may be related to the requested change.
21 6. Save the final version of the completed CO.
22

23 **3.2. EXECUTION OF THE CHANGE ORDER**

- 24 A. Upon saving the CO as described in section 3.1 above the software associated with the Project Management
25 Web Site shall notify the GC that the CO has been drafted and is ready for review. The GC shall do the following:
26 1. Open the appropriate CO form in the Construction Administration-Change Order Library and review all
27 items on the form.
28 2. The GC shall notify the CPM immediately of any errors or discrepancies on the form and shall not sign or
29 save it.
30 a. The CPM shall make any corrections as needed, re-save the form, and notify the GC.
31 3. If/when the GC concurs with the CO form as drafted the GC shall digitally sign the form and click SAVE.
32 B. After the GC digitally signs/saves the CO it shall be routed through the Project Management Web Site for
33 additional review and/or approvals. The CPM shall do the following:
34 1. Monitor the review process to ensure the software is working properly at each review step.
35 2. Ensure that proper BPW procedures are executed as needed by the CO approval process.
36 a. Schedule the CO on the next available BPW agenda if required.
37 i. Attend the BPW meeting to speak on the CO to board members and answer questions.
38 ii. The GC and/or the Project Architect (PA)/Project Engineer (PE) may be required to attend
39 the BPW meeting to address specific information as it relates to the Work and/or materials
40 associated with the CO.
41 3. Monitor final approval and distribution of the CO.
42 4. Notify the GC that the CO has been completed.
43 5. Ensure that the CO is posted to the next Public Works payment schedule.
44 6. Verify that the GC's next Progress Payment-Schedule of Values show the CO as part of the contract sum.
45 C. Upon final approval of the CO the GC may proceed with executing the Work associated with the CO.
46
47
48
49
50

END OF SECTION

**SECTION 01 29 73
SCHEDULE OF VALUES**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DOCUMENTS 1
8 1.4. BASIS OF VALUES 2
9 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
10 PART 3 - EXECUTION 2
11 3.1. AIA DOCUMENT G702 – APPLICATION AND CERTIFICATE FOR PAYMENT 2
12 3.2. AIA DOCUMENT G703 – CONTINUATION SHEET 2
13 3.3. INITIAL SCHEDULE OF VALUES SUBMITTAL 3
14 3.4. SOV FOR PROGRESS PAYMENT REQUESTS 3
15

PART 1 – GENERAL

1.1. SUMMARY

- 19 A. The Schedule of Values (SOV) is a Contractor provided statement that allocates portions of the total contract
20 sum to various portions of the contracted work and shall be the basis for reviewing the Contractors Progress
21 Payment Requests.
22 B. AIA Document G702 – Application and Certificate for Payment and AIA Document G703 Continuation Sheet shall
23 be filled out in sufficient detail to be used as a guideline in determining work completed and materials stored on
24 site when verifying Progress Payment Requests.
25 C. The General Contractor shall be responsible for filling out, updating, and providing these work sheets with each
26 Progress Payment Request.
27

1.2. RELATED SPECIFICATIONS

- 29 A. Section 01 26 63 Change Order (CO)
30 B. Section 01 29 76 Progress Payment Procedures
31 C. Section 01 31 23 Project Management Web Site
32 D. Section 01 32 26 Construction Progress Reporting
33 E. Section 01 33 23 Submittals
34 F. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
35 Works Construction”.
36 1. Use the following link to access the Standard Specifications web page:
37 <http://www.cityofmadison.com/business/pw/specs.cfm>
38 a. Click on the “Part” chapter identified in the specification text. For example if the specification
39 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
40 PDF will open.
41 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
42 to the referenced text.
43

1.3. RELATED DOCUMENTS

- 45 A. The following documents shall be used as the basis for initiating and maintaining the SOV worksheets throughout
46 the execution of this contract.
47 1. Drawing documents and specifications (including general provisions) as provided with the bid set
48 documents and any published addendums.
49 2. Documents associated with revisions or clarifications to number 1 above after awarding of the contract,
50 including but not limited to:
51 a. Construction Bulletins
52 b. Request for Information
53 c. Approved Change Orders
54 3. The latest daily/weekly Construction Progress Report
55 4. Other specifications as identified in Section 1.2 above

1
2 **1.4. BASIS OF VALUES**

- 3 A. The Contractor shall provide a breakdown of the Contract Sum in sufficient detail to assist the Architect and City
4 Project Manager in evaluating Progress Payment Requests. The breakdown detail may require a labor and
5 material breakdown for each division of work or trade or as directed by the CPM.
6 B. The total sum of all items shall equal the Contract Sum.
7

8 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

9
10 **PART 3 - EXECUTION**

11
12 **3.1. AIA DOCUMENT G702 – APPLICATION AND CERTIFICATE FOR PAYMENT**

- 13 A. The Contractor shall use AIA Document G-702 Application and Certificate for Payment with each Progress
14 Payment Request.
15 B. Completely fill out the Project Information section as follows:
16 1. TO OWNER; provide all owner related information as provided in the contract documents.
17 2. PROJECT; provide all contract information including contract number, title and address.
18 3. FROM CONTRACTOR; provide all contractor related information.
19 4. VIA ARCHITECT; provide all the architect's related information including the architect's project reference
20 number if different from the owners.
21 5. Indicate the current APPLICATION NO., PERIOD TO date, and CONTRACT DATE.
22 C. Completely fill out the Contractors Application for Payment section.
23 1. Fill out lines 1 through 9 to reflect the current status of the contract through the payment date being
24 requested.
25 2. The City of Madison calculates retainage on Public Works Contracts as follows:
26 a. In general, across the duration of the contract, 2.5% of the total contract sum, including change
27 orders, is withheld for retainage as referenced from the City of Madison Standard Specification
28 110.2:
29 i. Beginning with Progress Payment 1, 5% retainage will be withheld until such time that 50%
30 of the total contract sum has been paid out.
31 ii. No additional retainage will be withheld after 50% of the total contract sum has been paid,
32 unless additional change orders have been approved after the 50% milestone has been
33 reached. Per City of Madison Standard Specification 110.2, additional retainage up to 10%,
34 may be held in the event there are holds placed by Affirmative Action or liquidated
35 damages by BPW.
36 iii. Retainage for additional change orders after the 50% milestone will be withheld at the rate
37 of 2.5% of the total cost of the change order.
38 iv. Retainage is based on the change orders posted to the City's contract worksheet at the
39 time the progress payment is processed.
40 D. Completely fill out the Change Order Summary section. Only change orders that have been finalized and posted
41 to the City of Madison's Application for Partial Payment worksheet may be itemized into the SOV documents.
42 E. The Contractor shall sign and date the application and it shall be properly notarized.
43 F. The Contractor shall not fill in any information in the Architects Certificate for Payment section.
44

45 **3.2. AIA DOCUMENT G703 – CONTINUATION SHEET**

- 46 A. The Contractor shall use AIA Document G-703 Continuation Sheet to itemize their SOV for this contract. Provide
47 additional sheets as necessary.
48 B. Provide information in Column A (Item No.), Column B (Description of Work), and Column C (Scheduled Value) by
49 any method that allocates portions of the total contract sum to various portions of the contracted work.
50 Possible methods include combinations of the following:
51 1. By division of work
52 2. By contractor, sub-contractor, sub sub-contractor
53 3. By specialty item or group
54 4. Other methods of breakdown as may be requested by the City Project Manager or City Construction
55 Manager at the pre-construction meeting.
56 C. Provide total cost of the item/description of work including proportionate shares of profit and overhead related
57 to the item.
58

1 **3.3. INITIAL SCHEDULE OF VALUES SUBMITTAL**

- 2 A. The Contractor shall upload their initial SOV to the Project Management Web Site, Submittals Library, no later
3 than five (5) working days after the Pre-construction Meeting.
4 1. The initial SOV shall provide information in Column A (Item No.), Column B (Description of Work), and
5 Column C (Scheduled Value) only.
6 2. The level of detail shall be as described in section 3.2 above.
7 B. The Project Architect (PA)/Project Engineer (PE) and the City Project Manager (CPM) shall review the SOV as any
8 other submittal and may require modifications to reflect additional detail as necessary.
9 C. The Contractor shall resubmit the SOV as necessary until such time as the PPA and CPM have sufficient detail for
10 assessing and approving future Progress Payment Applications.
11 D. Progress Payment Application 1 will not be processed until such time as the Contractor has met this requirement
12 regardless of the amount of work completed per the application.
13

14 **3.4. SOV FOR PROGRESS PAYMENT REQUESTS**

- 15 A. The Contractor shall update the initial SOV with each Progress Payment Application as follows:
16 1. Initial items and values as part of Section 3.3 above will not be adjusted once the original Schedule of
17 Values submittal has been approved.
18 2. Change orders shall be added as additional items and values at the bottom of the SOV as they become
19 approved and posted to the City's contract worksheet. The value for each change order shall be the
20 value indicated on the SOV and shall stand alone. Values shall not be split out or combined with other
21 existing items with similar work descriptions on the original SOV.
22 3. Fill out Columns D, E, F and G to properly reflect the work completed and materials received since the last
23 Progress Payment Application.
24 4. Only materials delivered and stored on the project site may be reflected on SOV progress updates.
25 B. Provide updated G702 and G703 sheets with each Progress Payment application.
26 C. See Specification 01 29 76 Progress Payment Procedures for additional information on submitting Progress
27 Payment Applications.
28
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31 **END OF SECTION**
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SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

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13 3.2. PROJECT ARCHITECT PROCEDURE 5
14 3.3. CITY PROJECT MANAGER PROCEDURE 5
15

PART 1 – GENERAL

1.1. SUMMARY

- 19 A. The General Contractor (GC) shall review this and all related specifications prior to submitting progress payment
20 requests.
21 B. Progress payment requests (Partial Payment-PP) for this contract shall be uploaded digitally by the GC to the
22 Project Management Web Site
23 C. The Project Architect (PA)/Project Engineer (PE) and City Project Manager (CPM) shall review and amend or
24 approve the PP on the Project Management Web Site.
25 D. After approval of the PP by the CPM, they shall forward the PP to the appropriate agencies for BPW contractual
26 review and payment processing.
27

1.2. RELATED SPECIFICATIONS

- 29 A. Section 01 26 63 Change Order (CO)
30 B. Section 01 29 73 Schedule of Values
31 C. Section 01 31 19 Progress Meetings
32 D. Section 01 31 23 Project Management Web Site
33 E. Section 01 32 16 Construction Progress Schedules
34 F. Section 01 32 26 Construction Progress Reporting
35 G. Section 01 33 23 Submittals
36 H. Section 01 45 16 Field Quality Control Procedures
37 I. Section 01 77 00 Closeout Procedures
38 J. Section 01 78 13 Completion and Correction List
39 K. Section 01 78 23 Operation and Maintenance Data
40 L. Section 01 78 36 Warranties
41 M. Section 01 78 39 As-Built Drawings
42 N. Section 01 78 43 Spare Parts and Extra Materials
43 O. Section 01 79 00 Demonstration and Training
44

1.3. RELATED DOCUMENTS

- 46 A. The following documents shall be used when evaluating PP requests.
47 1. Daily and weekly construction progress reports filed since the last payment request.
48 2. Contractors Schedule of Values as updated from the last payment request. See Specification 01 29 73.
49 3. Any document that may be required to be submitted for review and approval, as noted by the
50 specifications listed in Section 1.2 above, or the Progress Payment Milestone Schedule in Section 1.4
51 below, to achieve a required bench mark of contract progression or contract requirement.
52

1.4. PROGRESS PAYMENT MILESTONES

- 54 A. City Engineering-Facility Management has developed the Project Payment Milestone Schedule (Section 1.4
55 below) to assist the GC in providing required construction specific documentation and general contractual
56 documentation in a timely manner.
57 B. The Progress Payment Milestone Schedule is not an all inclusive list. Multiple agencies review progress payment
58 requests and contract closeout requests. Missing, incomplete, or incorrect documentation for any agency may

- 1 be a cause for not processing progress payments. It shall be the sole responsibility of the Contractor for
2 providing documentation as required or requested to the appropriate agencies.
3 C. The milestone schedule is based on the contract total sum and shall be valid for most contracts. Milestone
4 submittals will be required with whatever progress payment hits the percentage of contract total indicated in
5 the schedule.
6 D. The CPM shall review the milestone schedule with each progress payment request and at their option may elect
7 to hold processing the progress payment until such time as the contractor has met the requirements for
8 providing construction specific documentation.
9 E. It shall be the General Contractors responsibility to comply with all BPW Contract Administration requirements
10 and related deadlines as outlined in the Award Letter, Award Checklist, and Start Work Letter.
11

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
BPW Contract Administration Documentation <ul style="list-style-type: none"> • Workforce profiles • Best Value Contracting Documentation • Sub-contractors prequalification approval & Affirmative Action plans • Other as may be required 	PP-1, or start work as applicable	<ul style="list-style-type: none"> • For GC and Sub-contractors before PP-1 regardless of scheduling • Sub-contractors (if applicable), due 10 days before they may start work • Sub-contractors (if applicable), due 10 days before they may start work
Required Construction Submittals/Administrative Documents <ul style="list-style-type: none"> • Contractors Project Directory • Schedule of Values • Submittals Schedule • Waste Management Plan • Closeout Requirement Checklist • Warranty Checklist 	PP-1	References <ul style="list-style-type: none"> • Specification 01 31 23 • Specification 01 29 73 • Specification 01 32 19 • Specification 01 74 19 • Specification 01 77 00 • Specification 01 78 36 • Various specifications.
Construction Progress Milestones <ul style="list-style-type: none"> • Early submittals, per submittal schedule • Detailed Contract Schedules 	PP-1	See specifications for specific requirements <ul style="list-style-type: none"> • Specification 01 32 19, Examples: concrete mix, structural steel, products with long lead times • See Specification 01 32 16
General Construction Progress Requirements are all up to date <ul style="list-style-type: none"> • Progress Schedules • Submittals/Re-submittals (ongoing) • Schedule of Values • Progress Reporting • LEED Documentation • Waste Management documentation • QMOs are being addressed and closed • Progress Cleaning • As-Built Drawings 	Each future PP	Verified with each Progress Payment Request <ul style="list-style-type: none"> • Specification 01 32 16 • Specification 01 33 23 • Specification 01 29 73 • Specification 01 32 26 • All specifications with LEED documentation requirements • Specification 01 74 19 • Specification 01 45 16 • Specification 01 74 13 • Specification 01 78 39
* All of the above are being updated on the Project Management Web Site as required		
BPW Contract Administration Documentation <ul style="list-style-type: none"> • Weekly payroll reports • Best Value Contracting Reports 	25% CT or PP 2	See 1.4.E above. <i>This progress payment will be withheld by BPW for any missing contractual documentation.</i>

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
<ul style="list-style-type: none"> SBE Reports 		
Construction Progress Milestones <ul style="list-style-type: none"> Construction/Contract Closeout Meeting #1 Submittals/Re-submittals complete 	50% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 33 23
Operation and Maintenance (O & M) drafts	60% CT	<ul style="list-style-type: none"> Specification 01 78 23
Construction/Contract Closeout Meeting #2 <ul style="list-style-type: none"> Construction closeout checklist 	70% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 77 00
BPW Contract Administration Documentation <ul style="list-style-type: none"> Request Finalization Review from BPW 	80% CT	This is a recommendation to the GC and is not a requirement of this PP. <ul style="list-style-type: none"> Specification 01 77 00
Construction Progress Milestones <ul style="list-style-type: none"> Operation and Maintenance (O & M) finals, accepted All major QMO issues resolved As-Built Drawings, Division Trades ready for GC review 	80% CT	<ul style="list-style-type: none"> Specification 01 78 23 Specification 01 45 16; Items that could prevent occupancy Specification 01 78 39
All of the following shall be completed for this PP: <ul style="list-style-type: none"> Regulatory Inspections completed All QMO reports closed Demonstration and Training completed Attic Stock completed Final Cleaning 	90% CT	Contractor to determine the proper order of completion: <ul style="list-style-type: none"> Governing ordinances and statutes Specification 01 45 16 Specification 01 79 00 Specification 01 78 43 Specification 01 74 13
Construction Closeout Procedures: <ul style="list-style-type: none"> Letter of Substantial Compliance sent to BI and DHS as needed Certificate of Occupancy issued As-Built Drawings, finals, accepted City Letter of Substantial Completion Warranty letters dated and issued 	100% CT	<ul style="list-style-type: none"> Specification 01 77 00 Generated/Signed by the Architect Building Inspection Specification 01 78 39 Signed by the City Engineer Specification 01 78 36
* Completion of this begins the one year warranty.		
BPW Contract Administration Documentation Contract Closeout Procedures <ul style="list-style-type: none"> Construction Closeout has been completed Contractor requests final payment of retainage upon receiving City Letter of Substantial Completion All BPW contractual requirements are verified 	Final	<ul style="list-style-type: none"> Specification 01 77 00 Contractor must provide any missing BPW Contractual Documentation
* Completion of this closes the contract but not the warranty period/bond.		

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
NOTE: CT = Contract Total less held retainage		

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1.5. PROGRESS PAYMENT SUBMITTAL

- A. Each progress payment submittal shall be:
 - 1. Digital in PDF format
 - 2. PDF shall be in color
 - 3. Uploaded to the appropriate Project Management library and properly named per the tutorial instructions provided to the awarded contractor.
- B. Submit all required construction progress documentation to the appropriate Project Management Web Site library.
- C. In general the following shall apply to all PP requests:
 - 1. Materials or products:
 - a. On order, being shipped, etc. may not be invoiced.
 - b. Received and stored on the project site may be invoiced.
 - c. Being manufactured off site at any location may not be invoiced (example: cabinetry, ductwork, etc.)
 - d. Completed products stored off site locally waiting for delivery to the project site may be invoiced with prior approval by the CPM. All of the following conditions must be met to be allowed:
 - i. Items must be visually inspected by CPM to verify product is complete.
 - ii. Item must be stored inside a compatible structure and the structure and contents must be insured.
 - iii. Contractor is responsible for condition until installation is completed.
 - 2. All labor and equipment, including rental time for the current progress period may be invoiced.
 - 3. Only completed installations may be invoiced to 100% based on the Schedule of Values.
- D. DO NOT submit BPW Contract Administration Documentation for review with Progress Payment Requests, submit them directly to the correct agency and in the correct format as instructed from information in your BPW Contract Award Packet instructions.

PART 2 - PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. GENERAL CONTRACTOR PROCEDURE

- A. The GC shall provide an updated version of their schedule of values (AIA documents G702 & G 703) with each PP request.
 - 1. The AIA - Application and Certificate for Payment (G702) shall be properly filled out and prepared for the Architects review. See specification 01 29 73, Schedule of Values for more information.
 - 2. The AIA - Continuation sheets (G703) shall be properly filled out and indicate the dollar value of the completed work to date for each item on the form. See specification 01 29 73, Schedule of Values for more information.
 - a. The GC shall subtotal the work completed to date for all of the original Schedule of Value items.
 - b. Divide the sub total of work completed by the Original Contract Total to obtain a percentage complete of the original Lump Sum Bid. This percentage may be taken out to five (5) decimal places (round fifth place up or down as needed).
 - i. Example: \$5,192.55 of completed work divided by \$10,000 original Contract Total = 0.519255, round this to 0.51926
 - c. Write the percentage in Column 10 on the City Tabular Sheet for the original lump sum bid item in RED ink.
 - 3. Ensure that any newly posted change orders from the City of Madison provided tabulation sheet have been entered on the G703 continuation sheets. Repeat steps a thru c above for each change order on the schedule of values and the City Tabular Sheet.
- B. The GC shall fill out the City of Madison Application and Certificate of Payment cover sheet as follows:
 - 1. The GC shall not change any pre-printed information and shall not write in the box that indicates previous progress payments.
 - 2. The GC shall sign and date the form where indicated.
 - 3. The GC shall provide the dates from and to for the PP being requested.

- 1 4. The GC shall provide the list of all contractors/sub-contractors that were actively working during the
2 dates indicated above.
- 3 a. All contractors/sub-contractors named must be in compliance with all City requirements (Pre-
4 qualified, Affirmative Action Plan on file, etc). The PP will be held and not processed by the City of
5 Madison until all contractors/sub-contractors are in compliance.
- 6 b. Do not list the names of suppliers or manufacturers, doing so will slow down processing and
7 require a re-submittal of the paperwork.
- 8 C. The General Contractor (GC) shall scan all of the documents listed below in the order shown, save the scan as a
9 single PDF file for each PP request.
- 10 1. City cover sheet – Application and Certificate for Payment
- 11 2. City tabulation sheet(s)
- 12 3. AIA G702 - Application and Certificate for Payment
- 13 4. AIA G703 - Continuation Sheet(s)
- 14 5. Any miscellaneous documents that may be requested as backup documentation for the pay request.
- 15 a. Lien waivers are not required and shall not be submitted.
- 16 b. Do not provide contractual administrative documents such as pay reports with pay requests.
- 17 c. Do not supply progress deliverables with pay requests.
- 18 F. Upload the pay request PDF to the Contract Documents-GC Partial Pay Apps library on the Project Management
19 Web Site.
- 20

21 **3.2. PROJECT ARCHITECT PROCEDURE**

- 22 A. The PA/PE shall review the AIA-continuation sheets provided by the GC to determine if the Schedule of Values
23 accurately reflects the work completed for the inclusive dates indicated.
- 24 B. The PA/PE shall advise the CPM of any discrepancies in the schedule of values.
- 25 C. The PA/PE shall work with the GC and the CPM to resolve any issues prior to signing the AIA - Application and
26 Certificate for Payment.
- 27 D. When verified, the PA/PE shall digitally sign the original PDF version of the AIA - Application and Certificate for
28 Payment on the Project Management Web Site.
- 29

30 **3.3. CITY PROJECT MANAGER PROCEDURE**

- 31 A. The CPM shall review all documents submitted by the GC and work with the PA/PE to ensure the schedule of
32 values accurately reflects the work completed to date.
- 33 B. The CPM may elect to hold processing of any progress payment pending submittal of required progress payment
34 milestones.
- 35 C. When verified, the CPM shall digitally sign the City Cover Sheet and forward the required documentation to the
36 appropriate City agencies for further processing of the payment request.
- 37 D. The CPM shall add a scanned copy of any documents indicating the PP request processing was completed to the
38 PMWS.
- 39

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41 **END OF SECTION**

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**SECTION 01 31 13
PROJECT COORDINATION**

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8 1.4. GENERAL CONTRACTOR PERFORMANCE REQUIREMENTS 2
9 1.5. SUB-CONTRACTOR PERFORMANCE REQUIREMENTS..... 2
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11 PART 3 – EXECUTION – THIS SECTION NOT USED 3
12

PART 1 – GENERAL

1.1. SUMMARY

- 16 A. Project Coordination covers many areas within the execution of the Contract Documents and the requirements
17 of proper coordination are the applicable to all contractors executing the Work of this contract.
18 B. This specification provides general information regarding project coordination for the General Contractor and all
19 Sub-contractors. All contractors shall be familiar with project coordination requirements and responsibilities
20 that may be defined in other specification within these Contract Documents.
21 C. The General Contractor shall at all times be responsible for the project, project site, and execution of the
22 Contract Documents.
23

1.2. RELATED SPECIFICATIONS

- 24 A. Section 01 29 76 Progress Payment Procedures
25 B. Section 01 31 19 Progress Meetings
26 C. Section 01 31 23 Project Management Web Site
27 D. Section 01 32 16 Construction Progress Schedules
28 E. Section 01 32 19 Submittals Schedule
29 F. Section 01 33 23 Submittals
30 G. Section 01 43 39 Mockups
31 H. Section 01 45 16 Field Quality Control Procedures
32 I. Section 01 60 00 Product Requirements
33 J. Section 01 77 00 Closeout Procedures, including all specifications referenced therein
34 K. Section 01 91 00 Commissioning
35
36

1.3. GENERAL REQUIREMENTS

- 37 A. The following general requirements shall applicable to all contractors:
38 1. Cooperate with the Owner, all authorized Owner Representatives, Project Architect and all consultants of
39 the Owner.
40 2. Materials, products, and equipment shall be new, as specified and to industry standards except where
41 otherwise noted.
42 3. Labor and workmanship shall be of a high quality and to industry standards.
43 B. Existing conditions:
44 1. Verify all existing conditions noted in the contract documents with actual filed locations. Verify
45 dimensions, sizes and locations, of structural, equipment, mechanical and utility components.
46 2. Report any inconsistencies, errors, omissions, or code violations in writing to the General Contractor (GC)
47 immediately.
48 3. Annotate any inconsistencies, errors, omissions on the GC As-Built record drawings immediately for
49 future reference.
50 C. Contract Documents:
51 1. The Contract Documents are intended to include everything necessary to perform the work. Every item
52 required may not be specifically mentioned, shown, or detailed.
53 a. Except where specifically stated all systems and equipment shall be complete, installed, and fully
54 operable.
55 b. If a conflict exists within the contract documents the contractor shall furnish the item, system, or
56 workmanship of the highest quality, largest, largest quantity, or most closely fits the intent of the
57 contract documents.
58

- 1 c. Manufacturers recommended installation details shall be verified and used prior to installation of
- 2 products and equipment so as to not void warranties.
- 3 D. Errors and Omissions
- 4 1. No Contractor shall take any advantage of any apparent error or omission in the construction documents.
- 5 2. The City of Madison shall be permitted to make such corrections and interpretations as may be deemed
- 6 necessary for the fulfillment of the intent of the construction documents.
- 7 E. Owners Representatives
- 8 1. All contractors shall be familiar with various Owner Representatives having Quality Management
- 9 responsibilities for the duration of this project including but not limited to the following:
- 10 a. Project Architect, responsible for all decisions affecting the code compliance and design intent of
- 11 the construction documents.
- 12 b. Consulting Architects and Engineers, responsible for providing consulting services to the Project
- 13 Architect, Owner, and City Project Manager, also responsible for Quality Management of the
- 14 construction documents.
- 15 c. Owner, the designated representative of the City Agency that will occupy the project upon
- 16 completion.
- 17 d. City Project Manager, responsible for all day to day decisions regarding the execution and
- 18 performance of this Public Works Contract.
- 19 e. Consulting City Staff, responsible for providing consulting services to the Project Architect, Owner,
- 20 and City Project Manager, also responsible for Quality Management of the construction
- 21 documents.
- 22 f. Commissioning Agent (CxA), responsible for ensuring that the project is meeting the Owner's
- 23 Project Requirements and related quality assurance procedures.
- 24 2. Owner Representatives shall be attending progress meetings, pre-installation meetings, performing or
- 25 being present for final testing and acceptance and quality management reporting during the execution of
- 26 the contract documents as outlined in other specifications.
- 27

28 **1.4. GENERAL CONTRACTOR PERFORMANCE REQUIREMENTS**

- 29 A. Assume the responsibility for all Work specified in the Contract Documents except where specifically identified
- 30 to be performed by the Owner or other contractor separately hired by the Owner.
- 31 1. Coordinate all work by Owner, equipment provided Owner, or contractor hired by the Owner into the
- 32 project schedule.
- 33 B. Provide all construction management responsibilities as specified in other Division 1 specifications including but
- 34 not limited to:
- 35 1. Scheduling of work
- 36 2. Coordination of work between other Trades and Sub-contractors
- 37 3. Construction administration and management
- 38 4. Site layout, cleanliness, and protection of completed work/stored materials
- 39 5. Waste Management
- 40 6. Quality Assurance and Quality Control
- 41 C. Use Diggers Hotline and private utility locating companies to accurately locate all public and private utilities on
- 42 the property as needed. The GC is responsible for any repair or replacement to any public or private utility
- 43 damaged during the execution of the Work
- 44 D. Report any inconsistencies, errors, omissions, or code violations in writing to the Project Architect immediately.
- 45 Failure to report inconsistencies prior to beginning work shall indicate that the GC accepted all existing
- 46 conditions.
- 47 E. The GC shall be responsible for assigning work and related responsibilities where the Contract Documents may
- 48 not clearly state who is responsible for providing the work, material, or product.
- 49 F. Provide construction management oversight of all items described in Section 1.5 below.
- 50 G. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.
- 51

52 **1.5. SUB-CONTRACTOR PERFORMANCE REQUIREMENTS**

- 53 A. Be familiar with all of the contract documents as they pertain to your Work, adjacent work and the overall
- 54 progress of the project.
- 55 1. All Sub-contractors shall be familiar with all Division 1 specifications as they may apply to progress,
- 56 progress payments, quality control construction management, and closeout of the contract.
- 57 B. Coordinate your Work with all adjacent work and existing conditions.

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1. Perform your work in proper sequence according to the GC's project schedule and in relation to the work of other trades.
 2. Notify other sub-contractors and trades whose work may be connected to, combined with, or influenced by your work and allow them reasonable time and access to complete their work.
 3. Join your work to the work of others in accordance with the intent of the Contract Documents.
 4. Order materials and schedule deliveries to facilitate the general progress of the Work.
- C. Cooperate with all other trades to facilitate the general progress of the work. This shall include providing every reasonable opportunity for the installation of work by others and the storage of their materials and equipment.
1. In no case shall any contractor exclude from the premises or work any Sub-contractor or their employees.
 2. In no case shall any contractor interfere with the execution or installation of Work by any other Sub-contractor or their employees.
- D. Arrange your work, equipment, and materials and dispose of your construction waste so as to not interfere with the work or storage of materials of others.
- E. Coordinate all work as indicated during pre-installation meetings with Owner Representatives, the GC and other trades. Any work improperly coordinated shall be relocated as designated by the Owner Representative at no additional cost to the City.
- F. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

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**SECTION 01 31 19
PROJECT MEETING**

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16 3.7 OTHER SPECIAL MEETINGS 3
17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The purpose of this specification is to identify various project related meetings and the responsible parties for
22 scheduling, agendas, minutes, and required attendance.
23 B. This specification is not intended to be inclusive of all meeting types or a complete list of required meetings.
24 C. This specification is not intended to cover planning and execution meetings between the General Contractor
25 (GC) and their sub-contractors.
26

1.2. RELATED SPECIFICATIONS

- 27
28 A. 01 31 23 Project Management Web Site
29 B. 01 32 16 Construction Progress Schedules
30 C. 01 43 39 Mockups
31 D. 01 91 00 Commissioning
32

1.3. PROJECT MEETING TYPES

- 33 A. The following project meeting types may be used but not limited to the following
34 1. Preconstruction Meeting
35 2. Project Management Web Site – Tutorial Meeting
36 3. Construction Progress Meetings
37 4. Pre-installation Meetings (including mock-up review meetings)
38 5. Weekly Trade Meetings
39 6. Special Meetings
40 7. Commissioning Meetings
41
42

1.4. GENERAL REQUIREMENTS

- 43 A. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and
44 authorized to act on behalf of the entity each represents.
45
46

PART 2 – PRODUCTS – NOT USED IN THIS SECTION

PART 3 - EXECUTION

3.1. PRECONSTRUCTION MEETING

- 50
51 A. After execution of the Contract the City Project Manager (CPM) shall schedule and conduct the Preconstruction
52 Meeting at the Owner’s facilities. The CPM shall coordinate the meeting agenda with the Project Architect and
53 the GC Project Manager.
54 B. The CPM shall be responsible for the final agenda.
55 C. The CPM and Project Architect shall take notes on the meeting and post completed meeting minutes.
56 D. Attendance shall be required by all of the following:
57 1. Owner Representative(s)
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2. Architect and applicable sub consultant(s)
 3. General Contractor and applicable subcontractors and suppliers
 4. City Quality Management Staff
 5. Commissioning Agent
 6. Others, as may be invited for particular agenda items.
- E. Topics of the Preconstruction Meeting shall include but not be limited to the following:
1. Staff and contractor introductions
 2. Completion Date
 3. BPW Administrative requirements and due outs
 - a. Small Business Enterprise (SBE) (if applicable)
 - b. Certified payroll forms
 - c. Workforce profiles
 - d. Best Value Contracting (BVC)
 4. General Facility Management Division 1 Specifications, including:
 - a. Section 01 29 76 Progress Payment Procedures
 - b. Section 01 31 23 Project Management Web Site (overview)
 - c. Section 01 45 16 Field Quality Control Procedures
 - d. Section 01 77 00 Closeout Procedures
 - e. Section 01 91 00 Commissioning
 5. Project Meeting scheduling
 - a. Section 01 31 19 Project Meetings
 6. Construction Schedule
 7. Commissioning Process

3.2. PROJECT MANAGEMENT WEB SITE – TUTORIAL MEETING

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- A. The CPM shall schedule and conduct a tutorial presentation of the PMWS prior to the beginning of construction.
 - B. The CPM shall be responsible for the final agenda, there will be no minutes.
 - C. The required attendance list in 3.1.D. above shall apply except for City Staff in items 1 and 4 who are already familiar with the PMWS system.
 - D. It is recommended that all contractors bring their lap top, tablet or other internet capable device with them including a fully charged battery and internet connection devices as necessary.

3.3. CONSTRUCTION PROGRESS MEETINGS

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- A. In general all of the following shall apply:
 1. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
 2. The attendance shall be from the required attendance list in 3.1.D. above.
 - B. The General Contractor Project Manager (GCPM) shall:
 1. Schedule and conduct all construction progress meetings biweekly or more frequently as required.
 2. Prepare agenda for meetings including, but not limited to the following:
 - a. Safety
 - b. Current Schedule, including review of the critical path and 6-week look ahead schedule
 - c. Status of project related documentation (Submittals, RFIs, CBs, etc.)
 - d. Quality Observation Log and status of correction of deficient items
 - e. Project questions and issues from meeting attendees
 - f. BPW Administration Check
 - g. Other as needed
 - h. Status of CORs and COs to be reviewed outside the standard progress meeting time.
 3. Make physical arrangements for meetings.
 4. GCPM to post meeting agendas to the appropriate libraries on the Project Management Web Site (PMWS) no less than two (2) working days prior to the scheduled meeting. Notify all required attendees, applicable parties to the contract, and others affected of the posted meeting agenda.
 5. Preside at meetings.
 6. Route a meeting attendance roster for attendees to sign-in on.
 7. GCPM to record the minutes of the meeting; include significant proceedings and decisions. Post meeting minutes to the PMWS no more than two (2) working days after the completed meeting. Meeting minutes shall include a scanned copy of the attendance sign-in sheet. Notify all required meeting attendees, applicable parties to the contract, and others affected by decisions made at the meetings.

1 8. The above requirements do not apply to GC/sub-contractor meetings.
2

3 **3.4. PRE-INSTALLATION MEETINGS**

- 4 A. The GCPM shall schedule and conduct all pre-installation meetings, including mockup reviews, before each
5 construction activity that requires coordination with other trades.
6 B. The GCPM shall be responsible for the final agenda and meeting minutes.
7 C. The GCPM will work with all concerned parties to resolve issues as needed and submit RFI's if necessary.
8 D. Required attendance shall be from the list in 3.1.D. above and shall be personnel having a stake in the outcome
9 of the installation or knowledge of the system being installed.
10 E. In the event the Contractor installs equipment or materials without a pre-installation meeting the Contractor
11 shall be solely responsible for removing, replacing, repositioning materials and equipment as instructed by the
12 Project Architect or City Project Manager at no additional cost to the City.
13

14 **3.6 PRE-CONTRACT CLOSEOUT MEETINGS**

- 15 A. Two (2) Pre-contract Closeout Meetings shall be held to review the closeout procedures, requirements, and
16 contract deliverables.
17 1. Pre-contract Closeout Meeting #1 shall be scheduled prior to the 50% Progress Payment Request is being
18 requested. This meeting shall discuss items such as closing out QMO reports, providing O&M drafts and
19 finals, payroll and Affirmative Action documentation, and other contract deliverables.
20 2. Pre-contract Closeout Meeting #2 shall be scheduled prior to the 80% Progress Payment Request is being
21 requested. This meeting shall discuss, but not be limited to, the status of scheduling final regulatory
22 inspections, cleaning up outstanding QMO's, demonstration and training, attic stock; and finalization
23 review of payroll and other related documents.
24 B. The GCPM shall schedule, coordinate, and make physical arrangements for both meetings.
25 C. All of the following shall be required to attend both meetings:
26 1. The GCPM and the GC Field superintendent
27 2. All Subcontractor Project Managers regardless of the current status of their work.
28 a. The GCPM may excuse a Subcontractor PM if they are confident that all contractual requirements
29 for closeout by the subcontractor have been completed and/or delivered to the GCPM. The list of
30 attendees shall be reviewed and agreed upon with CPM ahead of the meeting.
31 b. At the option of these project managers the field supervisors may also attend.
32 3. The Project Architect and at least one design consultant from each discipline represented by the plans
33 and specifications to address open QMOs, final tests, reports, etc.
34 4. The Owner
35 5. The CPM
36 6. Quality Management staff as needed to address open QMOs, final tests, reports, etc.
37 7. The Commissioning Agent
38 D. The CPM shall publish an agenda and chair the meeting.
39

40 **3.7 OTHER SPECIAL MEETINGS**

- 41 A. The Contractor shall schedule special meetings per the requirements of the LEED Specification, the Project
42 Quality Management Plan, the Commissioning Plan and as indicated by other specifications.
43 B. Special meetings include but are not limited to the following:
44 1. Waste Management Conference
45 2. Equipment start up meetings
46 3. Testing and balancing meetings
47 4. Commissioning meetings
48 5. Other meetings as necessitated by the contract documents
49
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**SECTION 01 31 23
PROJECT MANAGEMENT WEB SITE**

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8 2.1. AUTODESK CONSTRUCTION CLOUD SYSTEM RELATED PRODUCTS 2
9 PART 3 - EXECUTION 2
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12
13

PART 1 – GENERAL

1.1. GENERAL DESCRIPTION

- 17 A. The City of Madison (CoM) has established a cloud-based Project Management Tool (PMT) using an Autodesk
18 product called Autodesk Construction Cloud (ACC).
19 B. The software is used throughout the design, construction and warranty process of major remodels and new
20 construction projects.
21 C. Initially deployed in mid-2023, the PMT software will be deployed on all projects. The PMT software is cloud-
22 based software and therefore will receive regular updates and enhancements.
23

1.2. AUTODESK CONSTRUCTION CLOUD PROCEDURE OVERVIEW

- 25 A. The CoM PMT is 3 main modules. The [Autodesk Docs \(https://help.autodesk.com/view/DOCS/ENU/\)](https://help.autodesk.com/view/DOCS/ENU/) module is a
26 document management file system that is the foundation of ACC. The [Build](https://help.autodesk.com/view/BUILD/ENU/)
27 <https://help.autodesk.com/view/BUILD/ENU/> module has many sections that assist in performing day to day
28 functions of design/construction management while reducing the use of different software platforms, surface
29 mail, email and email attachments. Finally, the [Cost management](https://help.autodesk.com/view/BUILD/ENU/?guid=Cost_Overview)
30 https://help.autodesk.com/view/BUILD/ENU/?guid=Cost_Overview module is used to manage project finances.
31 1. Files within Autodesk Docs can store a wide variety [file formats](https://help.autodesk.com/view/DOCS/ENU/?guid=Supported_Files_Docs)
32 https://help.autodesk.com/view/DOCS/ENU/?guid=Supported_Files_Docs including but not limited to
33 Word, Excel, PDF, photographs (all popular formats), etc.
34 2. The Issues section within the Build module is used for Punch Lists, Quality Control and Warranty issues.
35 3. File Folder and module section access are controlled by Permission Groups and Permission Level
36 B. A tutorial document on the web based PMT will be provided to the General Contractor (GC) who is awarded the
37 contract. Additional training will be provided as needed for the GC and Sub-Contractors (SC) by the CoM.
38 C. The PMT has predefined work flows that channel automated alerts as documents are uploaded, reviewed, and
39 completed. These workflows are designed for inbound information from the contractor as well as outbound
40 information from the Architectural/Engineer consultant and the Owner.
41 D. The GC will be required to receive email notifications, access the internet to review related documentation and
42 be able to upload/download documentation to the various project modules or folders.
43 E. The SC's will be required (at a minimum) to receive email notifications and access the internet to review related
44 documentation. Prior to setting up the final PMT the GC and CPM shall meet to review all ACC workflows, the
45 GC will determine to what level over the minimum requirements the SC's will be involved.
46

1.3. RELATED SPECIFICATIONS

- 48 A. The following specification sections are directly related to the CoM PMT system.
49 1. 01 25 13 Product Substitution Procedures
50 2. 01 26 13 Request for Information (RFI)
51 3. 01 26 46 Construction Bulletins (CB)
52 4. 01 26 57 Change Order Request (COR)
53 5. 01 26 63 Change Order (CO)
54 6. 01 29 76 Progress Payment Procedures
55 7. 01 31 19 Project Meetings
56 8. 01 32 16 Construction Progress Schedules
57 9. 01 32 26 Construction Progress Reporting

- 1 10. 01 32 33 Photographic Documentation
- 2 11. 01 33 23 Submittals
- 3 12. 01 45 16 Field Quality Control Procedures (Owner)

4
5 **PART 2 - PRODUCTS**

6
7 **2.1. AUTODESK CONSTRUCTION CLOUD SYSTEM RELATED PRODUCTS**

- 8 A. Autodesk Construction Cloud is an Autodesk based software that requires no additional software installation,
9 hardware or other special requirements/applications for the users. There are no costs associated with the use of
10 this system.
- 11 B. Please consult Autodesk's web site for the [latest system requirements](https://help.autodesk.com/view/BUILD/ENU/?guid=System_Requirements_ACC)
12 (https://help.autodesk.com/view/BUILD/ENU/?guid=System_Requirements_ACC)

13 **PART 3 - EXECUTION**

14
15 **3.1. POST BID-OPENING**

- 16 A. After bids have been opened, a successful bidder has been determined, and bid acceptance procedures have
17 been initiated the City Project Manager (CPM) will contact the GC to provide the following information.
 - 18 1. [Autodesk Construction Cloud Help \(https://help.autodesk.com/view/BUILD/ENU/\)](https://help.autodesk.com/view/BUILD/ENU/) and [Learning Center \(https://learnacc.autodesk.com/\)](https://learnacc.autodesk.com/) are kept up to date with latest ACC features.
 - 19 2. For more customized workflows, Project Management Software Tutorials have been developed. These
20 tutorials are in a PDF printable format with screen shots and associated instructions on how to access and
21 use the PMT.
 - 22 3. A blank Project Directory in an Excel spread sheet format. The contractor shall provide the following
23 information for GC and SC staffs as indicated on the spreadsheet. This will generally be the Project
24 Manager for the GC as well as the Sub-contractors and the GC Site Supervisor.
 - 25 a. Last Name, First Name
 - 26 b. Company Name
 - 27 c. Email address (valid, work related)
 - 28 4. Phone Contact number and professional name must be entered by each user themselves via
29 <https://profile.autodesk.com/>
 - 30 5. The GC shall provide the above information for all SC's where the GC is not self-performing the work.
 - 31 6. The GC may provide project foreperson information for work being self-performed if he/she so desires.

32
33
34 **3.2. POST PRE-CONSTRUCTION MEETING**

- 35 A. The GCPM will return the completed Project Directory spread sheet to the CPM no later than the Pre-
36 construction meeting.
- 37 B. The City Project Admin is responsible for uploading all project directory data into ACC, adding users to project
38 and licenses to users for all non-city staff (GC/SC staffs).
- 39 C. All GC/SC staff will be notified through an automated email from Autodesk directing them to create an Autodesk
40 account if they do not already have one. It is the responsibility of each GC/SC to follow the instructions to setup
41 their own account
- 42 D. Once the GCPM has received his/her project invitation, uploading of contract related documents can begin. This
43 would include but not be limited to project schedules, submittals, RFI's, and other documents as needed.
- 44 E. All workflows, review of documentation, and general archiving of construction related documentation will be
45 conducted on the PMWS. These documents will generally not be emailed.
- 46 F. The following documents related to the execution of the contract will not be part of the PMWS:
 - 47 1. All documentation related to executing the contract, such as:
 - 48 a. Sub Contractors list
 - 49 b. Affirmative Action documentation
 - 50 c. Bonding documentation
 - 51 d. Documentation associated with payroll verification
 - 52 e. Final documentation associated with closing out the contract
 - 53 2. Any documentation required/generated by ordinance, code or statute, such as;
 - 54 a. Erosion Control inspections
 - 55 b. Building Inspection Department inspections

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57
58 **END OF SECTION**

**SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULES**

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4 PART 1 – GENERAL 1
5 1.1. SCOPE 1
6 1.2. RELATED SPECIFICATIONS 1
7 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
8 PART 3 - EXECUTION 1
9 3.1. OVERALL PROJECT SCHEDULE (OPS) 1
10 3.2. 6 WEEK LOOK-OUT SCHEDULES (LOS) 1
11 3.3. PROJECT MANAGEMENT WEB SITE (PMWS) 2
12

PART 1 – GENERAL

1.1. SCOPE

- 16 A. This specification is to identify various project related schedules associated with indicating construction progress
17 and outlook. The following schedules are the responsibility of the General Contractor (GC).
18 1. Overall Project Schedule
19 2. 6 Week Look-out Schedule
20 B. This specification is not intended to include internal schedules generated by the contractors during their
21 planning and execution of the contract.
22

1.2. RELATED SPECIFICATIONS

- 23 A. Section 01 29 76 Progress Payment Procedures
24 B. Section 01 31 23 Project Management Web Site
25 C. Section 01 31 19 Progress Meetings
26 D. Section 01 74 13 Progress Cleaning
27 E. Section 01 77 00 Closeout Procedures
28 F. Section 01 78 23 Operation and Maintenance Data
29 G. Section 01 78 36 Warranties
30 H. Section 01 78 39 As-Built Drawings
31 I. Section 01 78 43 Spare Parts and Extra Materials
32 J. Section 01 79 00 Demonstration and Training
33 K. Section 01 91 00 Commissioning
34 L. Other specification within the construction documents that may indicate the need for scheduling any event with
35 Owner, Project Architect, Owner Representatives, including any owner provided equipment.
36
37

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. OVERALL PROJECT SCHEDULE (OPS)

- 43 A. The GC shall prepare an OPS that covers the duration of the contract from the pre-construction meeting through
44 the end of construction to final contract closeout.
45 1. The GC shall review Specification 01 77 00 Closeout Procedures to become familiar with definitions,
46 differences, and requirements for closing out the construction and contract including the association with
47 progress payments.
48 B. The GC shall provide copies and lead a discussion on the OPS during the pre-construction meeting.
49 C. The OPS shall indicate start and end dates of each task associated with the project.
50 D. The OPS shall clearly indicate the critical path of the project.
51 E. The GC shall update the OPS as often as necessary during the duration of the project. Updates will be briefed as
52 needed during bi-weekly progress meetings.
53

3.2. 6 WEEK LOOK-OUT SCHEDULES (LOS)

- 54 A. The GC shall prepare the initial LOS to include detail of daily tasks for the first six (6) weeks of construction in
55 depth for the Pre-construction meeting. The LOS shall be compatible and complimentary to the OPS.
56 B. The GC shall provide copies and lead a discussion on the LOS during the pre-construction meeting.
57

- 1 C. The LOS shall indicate start and end dates of each major task, associated related sub-tasks, and required parallel
- 2 or pre-requisite tasks required to complete the major task on time.
- 3 D. The LOS shall also include identifying and scheduling such events as:
- 4 1. Pre-installation meetings and mock-up review meetings.
- 5 2. Quality management reviews of installations before they are covered.
- 6 3. Owner provided equipment as designated by the contract documents.
- 7 4. Work by others as designated by the contract documents.
- 8 5. Critical submittal dates.
- 9 E. The GC shall update the LOS prior to each bi-weekly progress meeting to indicate the next 6 weeks of scheduled
- 10 work. Updates will be briefed during each bi-weekly progress meeting.
- 11

12 **3.3. PROJECT MANAGEMENT WEB SITE (PMWS)**

- 13 A. The GC shall upload all project schedules and updates to the PMWS in an original PDF version of the scheduling
- 14 document. Scans will not be permitted.
- 15

16
17 **END OF SECTION**
18

**SECTION 01 32 19
SUBMITTALS SCHEDULE**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DOCUMENTS 1
8 1.4. SUBMITTAL DEFINITIONS 1
9 1.5. SUBMITTAL REQUIREMENTS 2
10 1.6. ADMINISTRATIVE SUBMITTALS 2
11 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
12 PART 3 - EXECUTION 2
13 3.1. OVERALL RESPONSIBILITIES OF ALL CONTRACTORS 2
14 3.2. GENERAL CONTRACTORS RESPONSIBILITIES 2
15 3.3. STAFF REVIEW RESPONSIBILITIES 3
16

PART 1 – GENERAL

1.1. SUMMARY

- 20 A. The General Contractor shall submit a complete and comprehensive list of all submittals anticipated during the
21 execution of this contract.
22 B. The GC shall include the Administrative submittals identified in item 1.5 below and shall be required to up load
23 them to the Project Management Web Site.
24 C. The initial Submittals Schedule shall be based on the original contract documents used at the time of bidding and
25 any posted addenda through awarding of the contract.
26 D. The Submittal Schedule may be appended during the execution of the contract based on amendments to the
27 contract in the form of Change Orders, Construction Bulletins, and other related documents that add, or change
28 the scope of the work.
29

1.2. RELATED SPECIFICATIONS

- 30 A. Section 01 29 76 Progress Payment Procedures
31 B. Section 01 31 23 Project Management Web Site
32 C. Section 01 33 23 Submittals
33 D. Section 01 91 00 Commissioning
34
35

1.3. RELATED DOCUMENTS

- 36 A. The following documents shall be used as the basis for initiating the original Submittals Schedule.
37 1. Drawing documents and specifications (including general provisions) as provided with the bid set
38 documents and any published addenda.
39 B. The following documents shall be used to amend the submittals schedule as needed during the execution of this
40 contract.
41 1. Documents associated with revisions or clarifications to number A.1 above after awarding of the
42 contract, including but not limited to:
43 a. Construction Bulletins
44 b. Approved Change Orders
45
46

1.4. SUBMITTAL DEFINITIONS

- 47 A. Administrative Submittal: Any submittal that may be required by a Division 1 Specification and as noted in
48 Section 1.5 below.
49 B. Critical Path Submittal: Any early submittal that needs a priority review due to early construction use or long
50 lead times where a delay could affect the critical path of the construction schedule
51 C. Submittal: Any material, product, equipment, or general requirement as outlined in this and other specifications
52 that require a favorable review or acceptance prior to proceeding with procuring the item or proceeding with
53 the Work.
54
55

1.5. SUBMITTAL REQUIREMENTS

- A. The GC and all Sub-contractors shall review the construction documents including the specifications of their individual Division or Trade to compile a complete list of all materials, products, or equipment that will require a positively reviewed submittal to be completed prior to procurement and installation.
 - 1. Submittals shall include but not be limited to any of the following that may apply:
 - a. Shop Drawings
 - b. Product Data
 - c. Assembly Drawings
 - d. Engineered Drawings
 - e. Product Samples
- B. The following items will require an approved submittal, verify with specifications for specific needs and requirements:
 - 1. Contractor certifications for specialized work such as asbestos removal, well drilling, controls, AV, etc.

1.6. ADMINISTRATIVE SUBMITTALS

- A. The GC shall upload the following submittals within 15 working days of receipt of the City of Madison Start Work Letter. All Administrative Submittals shall be approved prior to requesting Progress Payment Number 1.
 - 1. Contractors Project Directory, see specification 01 31 23, discuss requirements with CPM
 - 2. Schedule of Values, see Specification 01 29 73
 - 3. Submittals Schedule, see Specification 01 32 19
 - 4. Waste Management Plan, see Specification 01 74 19
 - 5. Closeout Requirement Checklist, see Specification 01 77 00
 - 6. Warranty Checklist, see Specification 01 78 36

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. OVERALL RESPONSIBILITIES OF ALL CONTRACTORS

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of submittals to the General Contractor.
- B. Each list shall indicate the title of the submittal, the associated specification of the submittal, whether the submittal can be considered an early/middle/late submittal, the anticipated date the submittal will be provided and the anticipated date the submittal needs to be approved.
- C. Contractors shall be aware that the goals for submittal review by the Architect staff and City staff will be as follows:
 - 1. For items on the Critical Path as identified by the GC, five (5) working days
 - 2. For most other submittals ten (10) working days
 - 3. Additional time may be needed for complex submittals or if re-submittals are required.
- D. The general format of the Submittal Schedule shall be tabular as per this example:

<u>Title</u>	<u>Specification</u>	<u>Critical Path (Y or N)</u>	<u>Date provided</u>	<u>Date required</u>	<u>Remarks</u>
Concrete Mix Design	03 30 00	Y	Oct 1, 2014	Oct 15, 2014	
Paint Draw Downs	09 90 00	N	Jan 2, 2015	Jan 20, 2015	

3.2. GENERAL CONTRACTORS RESPONSIBILITIES

- A. The General Contractor shall be responsible for all of the following:
 - 1. Consolidating all submittal lists from individual contractors into one master list.
 - 2. Reviewing all submitted lists for completeness, timing with the overall contract, etc. The GC shall meet with individual contractors to make changes as necessary.
 - 3. Upload the completed Submittals Schedule to the Submittal Library on the Project Management Web Site for review as SD 003.0. See Specification 01 33 23 Submittals for more information on this procedure.
 - 4. Resubmit the schedule as needed after initial reviews have been completed.
- B. The GC shall work with other contractors to amend the Submittals Schedule throughout the execution of the project based on changes and modifications as needed.
- C. The GC and Project Architect shall be responsible for reviewing and briefing the submittal schedule and submittals status at each bi-weekly construction meeting.

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3.3. STAFF REVIEW RESPONSIBILITIES

- A. The Project Architect, consulting staff, Commissioning Agent (CxA), Owner, and city staff will review the Submittal Schedule for completeness per the plans and specifications within their divisions of work. The reviewing staff may provide comments as needed. Some examples might include the following:
 - 1. Submittal not required
 - 2. Provide photos of samples with digital submittal
 - 3. Insure one submittal for complete system
 - 4. Append the schedule to include...
 - 5. See Specification <xyz> for additional requirements
- B. The Project Architect and City Project Manager will finalize review comments regarding the Submittal Schedule. Re-submittal of the submittal schedule may be required.

END OF SECTION

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**SECTION 01 32 23
SURVEY AND LAYOUT DATA**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. SURVEYOR QUALIFICATIONS 1
8 1.4. QUALITY ASSURANCE 1
9 1.5. SUBMITTALS 2
10 1.6. EXAMINATION 2
11 PART 2 – PRODUCTS – NOT USED 2
12 PART 3 - EXECUTION 2
13 3.1. PRE-CONSTRUCTION OWNER SUPPORT 2
14 3.2. UTILITY LOCATING 2
15 3.3. SURVEY CONTROL AND LAYOUT DATA 2
16 3.4. TOPOGRAPHIC SURVEYING 2
17 3.5. SITE SURVEY AS-BUILT 3
18

PART 1 – GENERAL

1.1. SUMMARY

- 22 A. The purpose of this specification is to set forth the minimal required guide lines to be followed by the General
23 Contractor (GC) and the Land Surveyor (Surveyor) including but not limited to the following:
24 1. Surveyor Professional Requirements
25 2. Horizontal and Vertical Datum Control
26 3. Local Control (if any)
27 4. Electronic File and Data Requirements
28 5. As-Built Documentation Requirements
29 B. When working on any City of Madison project, OSHA standards must be complied with. The Surveyor shall
30 provide appropriate traffic control in accordance to the Manual on Uniform Traffic Control Devices (MUTCD).
31 C. The Surveyor shall be responsible for notifying Diggers Hotline in advance of beginning the field work for this
32 contract.
33

1.2. RELATED SPECIFICATIONS

- 34 A. Section 01 29 76 Progress Payment Procedures
35 B. Section 01 31 23 Project Management Web Site (Autodesk Construction Cloud)
36 C. Section 01 33 23 Submittals
37 D. Section 01 78 39 As-Built Drawings
38 E. Section 105.9, Survey Points and Instructions, of the City of Madison Standard Specifications for Public Works
39
40

1.3. SURVEYOR QUALIFICATIONS

- 41 A. The General Contractors, Land Surveyor Sub-Contractor shall meet or exceed the following:
42 1. The Principal Land Surveyor (PLS) shall be licensed to practice in the State of Wisconsin.
43 a. The PLS's license shall be current at the beginning of the contract and the PLS shall maintain an
44 active license throughout the execution of this contract.
45 2. The PLS shall have a minimum of minimum of ten (10) years of field experience on similar projects of
46 scope and size.
47 a. Land Surveyors working under the direction of the PLS shall have a minimum of five (5) years of field
48 experience on similar projects of scope and size.
49 B. The PLS shall be responsible for checking and verifying all work being performed under the PLS's direction during
50 the execution of this contract. This shall include but not be limited to periodic field checks of equipment and
51 survey data for accuracy and compliance with the contract documents.
52
53

1.4. QUALITY ASSURANCE

- 54 A. The PLS shall do all surveying in City of Madison Datum's as follows:
55 1. All Horizontal Control shall be in the Dane County Coordinates (WISCRS), NAD 83(1997) datum, US
56 Survey foot).
57 2. All Vertical Control shall be in NAVD88(1991).
58

- 1 3. Information on PLSS Section Corner Monuments and Tie Sheets can be found on the City Engineering
2 Mapping website http://gis.cityofmadison.com/Madison_PLSS/PLSS_TieSheets.html.

3
4 **1.5. SUBMITTALS**

- 5 A. After initial project setup the PLS shall provide the following information as a Survey Data Submittal for review
6 by the CPM/CCM, and Owner. See Specification 01 33 23 – Submittals for more information.
7 1. Copy of the PLS (and any supporting staff) current State of Wisconsin registration certificate/licenses.
8 2. Digital Survey Submittal on a thumb drive delivered to the CPM/CCM. Submittal Survey shall be on a
9 thumb drive or CD in AutoCAD 2017. Digital Submittal shall be of the project site setup showing all of the
10 following:
11 a. Key features not scheduled for demolition, including but not limited to building corners, roof
12 overhangs, and door locations.
13 b. Location of construction limits fencing.
14 c. Locations of PLSS and/or project control points provided by the Owner.
15 d. Locations of project based control points.
16 3. Printed Survey Submittal shall be the same as item 1 above in PDF format. PDF file shall be formatted to
17 print to scale on 24"x36" sheets as required to show all features with text neatly organized for each item
18 identified. When multiple sheets are used a match line and sheet references shall be required.
19 4. PDF file of the complete level/layer scheme. Scheme shall be in tabular form formatted to 8.5 by 11
20 paper and shall include all of the following:
21 a. Level/layer designation (abbreviation).
22 b. Level/layer designation (full title).
23 c. Feature attribute characteristics (line weight, line style, font, etc.).
24 d. Cell attribute information
25 e. Samples of line styles and cells.

26
27 **1.6. EXAMINATION**

- 28 A. The PLS shall be responsible for verifying all site data including the owner provided local control points (see
29 Section 3.1 below) prior to starting the Work.
30 B. Notify the Project Architect and CPM/CCM immediately if any discrepancies are discovered.

31
32 **PART 2 – PRODUCTS – NOT USED**

33
34 **PART 3 - EXECUTION**

35
36 **3.1. PRE-CONSTRUCTION OWNER SUPPORT**

- 37 A. The CPM/CCM shall provide the GC/PLS with a digital CAD seed file on or before the Pre-construction meeting.
38 1. Seed file shall be an AutoCAD seed file using the datum indicated above. Seed file shall be delivered as
39 an AutoCAD format as requested by the PLS.
40 a. Seed file shall be used as the PLS's initial base file for all future work on this contract.

41
42 **3.2. UTILITY LOCATING**

- 43 A. The GC and/or PLS shall be responsible for notifying Diggers Hotline for all utility locate requests.
44

45 **3.3. SURVEY CONTROL AND LAYOUT DATA**

- 46 A. The GC and PLS are responsible for all other survey control and layout data required to perform the work in this
47 contract.

48
49 **3.4. TOPOGRAPHIC SURVEYING**

- 50 A. The Surveyor may perform the topographic survey with properly calibrated equipment as follows:
51 1. Total station, achieving minimum accuracy for well-defined features of +/- 0.1 feet horizontal and +/-0.04
52 feet vertical at 95% confidence relative to control. "Well defined features" shall include but not be
53 limited to property irons, pavements, trees, landscaping features, buildings, utility locations, and other
54 permanent features.
55 2. RTK GPS shall be permitted in large open areas, along tree lines, and in brushy areas.
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3.5. SITE SURVEY AS-BUILT

- A. See Specification 01 78 39 As-Built Drawings, Section 3.2 for more information on required record site information to be provided prior to contract closeout.
- B. The GC shall be responsible for scheduling the PLS to capture locations and depths of all buried utilities prior to any contractor back filing trenches. The Owner may require missing information to be located and surveyed at the GC's expense.

END OF SECTION

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**SECTION 01 32 26
CONSTRUCTION PROGRESS REPORTING**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS 1
8 PART 2 – PRODUCTS - THIS SECTION NOT USED 1
9 PART 3 - EXECUTION 1
10 3.1. CONTRACTOR JOURNAL 1
11 3.2. CONSTRUCTION PROGRESS MEETINGS 2
12

PART 1 – GENERAL

1.1. SUMMARY

- 16 A. Daily records of project activities, resources used, weather conditions, and other information related to the
17 ongoing progress of the project are extremely important at all levels of Construction Management.
18 B. Daily records provide the base for weekly progress reports and updating progress schedules.

1.2. RELATED SPECIFICATION SECTIONS

- 21 A. Section 01 31 19 Project Meetings
22 B. Section 01 31 23 Project Management Web Site
23 C. Section 01 32 23 Photographic Documentation
24

1.3. PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS

- 26 A. The General Contractor (GC) shall be responsible for all Construction Progress Reporting as outlined in this and
27 other specifications as noted.
28 B. The GC shall maintain daily progress journals in a format of their choosing provided it is legible and contains the
29 information as outlined in Section 3.1 below.
30 C. The journal shall be located in the job trailer and shall be reviewable by the Project Architect or City Project
31 Manager if so requested.
32

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. CONTRACTOR JOURNAL

- 38 A. The GC shall maintain a journal of daily progress on which Work is performed by any employee or entity for
39 which the GC is responsible. Such reports shall include all relevant data concerning the progress of Work
40 activities the GC and Subcontractors are responsible for and the effect of that activity on the time of
41 performance of the Contract.
42 1. Some projects may not require weekly journals be kept instead of daily journals. This is at the sole
43 discretion of the City Project Manager. A daily journal will generally be required when the contract has a
44 significant amount of site work. A weekly journal will generally be used when a contract is interior work
45 only.
46 B. Journal entries shall be made on the Contractor Daily/Weekly Report Form located in the Construction Progress-
47 Daily Journal Library on the Project Management Web Site. The form consists of the following areas:
48 1. Weather; include temperature, humidity, precipitation, wind and other related information such as
49 significant storm events, times, and details.
50 2. Work completed by trade
51 3. Delays encountered
52 4. Deliveries received or delayed
53 5. Hot issues that need to be addressed
54 6. Safety issues
55 7. Photograph progress and upload to the Photo Library on the Project Management Web Site.
56 8. Other including inspections, testing, etc.
57 9. Space for attaching documents

- 1 C. Contractor Daily/Weekly Report Forms shall be completed and signed by the GC's Job Superintendent or other
2 on-site representative authorized by the GC confirming each such report is current, accurate and complete.
3 D. If applicable the GC shall include schedules of quantities and costs, progress schedules, wage rates, reports,
4 estimates, invoices, records and other data as requested by the CPM concerning Work performed or to be
5 performed under this Contract if the CPM determines such information is needed to substantiate Change Order
6 proposals, claims, or to resolve disputes.
7

8 **3.2. CONSTRUCTION PROGRESS MEETINGS**

- 9 A. The GC shall provide a verbal summary of the previous two (2) weeks progress reports at each bi-weekly
10 construction progress meeting.
11

12 **END OF SECTION**
13
14

SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

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4 PART 1 – GENERAL 1
5 1.1. SCOPE 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. SUBMITTALS 1
8 PART 2 – PRODUCTS 1
9 2.1. DIGITAL CAMERA 1
10 PART 3 – EXECUTION 1
11 3.1. REQUIREMENTS FOR DIGITAL PHOTOGRAPHS 1
12 3.3. PROJECT MANAGEMENT WEB SITE - AUTODESK CONSTRUCTION CLOUD (ACC) 2
13

PART 1 – GENERAL

1.1. SCOPE

- 17 A. The General Contractor (GC) shall be required to take weekly digital photographs of interior and exterior
18 construction progress and upload the photos directly to the Project Management Web Site (ACC).
19

1.2. RELATED SPECIFICATION SECTIONS

- 21 A. Section 01 29 76 Progress Payment Procedures
22 B. Section 01 31 23 Project Management Web Site (ACC)
23 C. Section 01 32 19 Submittals Schedule
24 D. Section 01 32 33 Submittals
25 E. Section 01 77 00 Closeout Procedures
26

1.3. SUBMITTALS

- 28 A. The GC shall provide general information on the type of camera being used for interior and exterior digital
29 photographs.
30 1. Information may be written on Contractor’s transmittal sheet.
31 a. Include camera name/type, aspect ratio setting, and average file size
32 b. Provide sample project pictures as part of PDF submittal.
33

PART 2 – PRODUCTS

2.1. DIGITAL CAMERA

- 37 A. All digital photographs shall be taken with a good quality digital camera, cell phone, tablet, and other such digital
38 device.
39 B. Digital photographs shall be formatted to achieve a good, clear, and detailed image where the final file size is
40 between 600 KB and 3.0 MB (3000KB).
41

PART 3 – EXECUTION

3.1. REQUIREMENTS FOR DIGITAL PHOTOGRAPHS

- 45 A. The GC shall take a minimum of two (2) exterior photographs each week. Exterior photographs will not be
46 required on projects that do not include any exterior work.
47 1. Exterior photos shall be taken from approximately the same location each week for the duration of the
48 project.
49 2. When applicable this requirement shall begin prior to commencing any site work.
50 3. This requirement shall only be applicable when there is exterior work actively being conducted with the
51 project. Periods of inactivity due to weather (winter conditions) do not require a photograph.
52 4. This requirement shall end when the exterior work has been substantially completed.
53 5. This requirement may be suspended due to weather conditions or substantial delays in exterior progress.
54 B. The GC shall take interior photographs each week that document interior construction progress.
55 1. This requirement will begin when exterior wall framing begins.
56 a. When an interior remodeling project includes demolition work interior photos shall be taken
57 during the demolition process.
58 2. Pictures do not need to be taken from the same location each week.

- 1 3. This requirement shall end when the interior work has been substantially completed.
- 2 C. Digital photographs shall be properly zoomed in/out, and flash used as needed, to capture a level of detail
- 3 required to properly show the progress being captured by the photograph.
- 4 1. Blurry and dark pictures will not be accepted.
- 5 D. The camera default naming convention is acceptable. The GC does not need to rename or specifically identify
- 6 pictures with a title.
- 7 E. All digital photographs shall be saved in a JPEG (.jpg) format and uploaded directly to the Autodesk Construction
- 8 Cloud (ACC) project images library.
- 9 1. The GC shall upload the photos to the folder that designates the appropriate construction week and date
- 10 (beginning Monday date). If no folder exists, contact the CPM/CCM prior to uploading photos.
- 11

12 **3.3. PROJECT MANAGEMENT WEB SITE - AUTODESK CONSTRUCTION CLOUD (ACC)**

- 13 A. The CPM/CCM shall provide weekly progress folders in the Project Images Library on ACC.
- 14 1. Progress folders are labeled with the Construction Week Number and the date for Monday of that week.
- 15 2. The GC shall notify the CPM/CCM if additional weekly progress folders need to be created.
- 16 B. The GC shall upload the weekly digital photographs to the appropriate progress folder in the Project Images
- 17 Library.
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END OF SECTION

**SECTION 01 33 23
SUBMITTALS**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED REFERENCES 1
7 1.3. SUBMITTAL REQUIREMENTS 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
9 PART 3 - EXECUTION 2
10 3.1. GENERAL CONTRACTORS PROCEDURES 2
11 3.2. SUBMITTAL REVIEW 3
12 3.3. PROJECT ARCHITECTS REVIEW 3
13

PART 1 – GENERAL

1.1. SUMMARY

- 17 A. The General Contractor (GC) shall be responsible for providing submittals for review of all contractors and sub-
18 contractors as designated in the construction documents. Submittals shall include but not be limited to all of the
19 following:
20 1. Equipment specified and pre-approved in the specification; to ensure quality, construction, and
21 performance specifications have not changed since final design.
22 2. Equipment specified by performance in the specification; to ensure that the intended quality,
23 construction, and performance specified is met by the selected material or product.
24 3. Shop, piece, erection, and other such drawings as indicated in the specifications to ensure all structural,
25 dimensional, and assembly requirements are being met.
26 4. Submittals indicating installation sequencing
27 5. Submittals indicating control sequencing
28 6. Contractor licensing, certification, and other such regulatory documentation when required by a
29 specification.
30 7. Other submittals as may be required by individual specifications.
31 B. The submittal process shall not be used to determine alternates to specified products or equipment. All
32 considerations shall be reviewed during the bidding process and acceptable alternates shall be acknowledged by
33 addendum prior to the closing of bidding. See bidding instructions for the information on submitting alternates
34 for consideration.
35 D. In the event that a manufacturer has significantly changed a product (discontinued a model, changed dimension
36 or performance data changed available colors, etc.) since bid opening the GC shall submit a Request for
37 Information (RFI) to the Project Architect requesting other approved alternates prior to uploading a digital
38 submittal.
39 E. Contractors and sub-contractors shall be responsible for knowing the submittal requirements of ALL sections
40 within their scope of work under the contract. The Owner reserves the right to request documentation on any
41 materials, equipment, or product being installed where a submittal is not on file. If the material, equipment, or
42 product installed is determined not to meet the intent of the specification the contractor/sub-contractor shall be
43 required to remove and replace the items involved. The GC shall be solely responsible for all costs associated
44 with the removal and replacement.
45

1.2. RELATED REFERENCES

- 46 A. Section 01 29 76 Progress Payment Procedures
47 B. Section 01 31 23 Project Management Web Site
48 C. Section 01 32 19 Submittals Schedule
49 D. Section 01 32 26 Construction Progress Reporting
50 F. All Technical Specifications, contract documents, construction drawings, and any published addendums during
51 the bidding process.
52 G. All contract documents generated during the execution of the contract including but not limited to Requests for
53 Information (RFI) and Construction Bulletins (CB).
54
55

1.3. SUBMITTAL REQUIREMENTS

- 56 A. A completed submittal shall meet the following requirements:
57

- 1 1. Digital submittal shall be original PDF of manufacturer's data sheets or high quality color scan of the
- 2 same.
- 3 a. Submittals shall not include sales fliers or other similar documents that typically do not provide
- 4 complete manufacturers data.
- 5 2. Documents within the PDF submittal shall be printable to a sized sheet no less than 8-1/2 by 11 inches
- 6 and no larger than 24 by 36 inches.
- 7 3. At the beginning of each submittal the contractor shall identify the plan reference (WC-1, EF-3, etc.) in
- 8 RED block letters that the submittal is for.
- 9 4. Where multiple model numbers appear in a table the contractor shall identify the specific model being
- 10 submitted by using a RED square, box, or other designation to distinguish the correct model from others
- 11 on the page.
- 12 B. A complete submittal will include all information associated with the product or equipment as presented in
- 13 plans, equipment tables, and specifications. Information shall include but not be limited to the following:
- 14 1. Dimensional data
- 15 2. Performance data
- 16 3. Resource requirements, power, water, waste, etc
- 17 4. Clearance and maintenance requirements
- 18 5. Finish information, colors, textures, etc.
- 19 6. Warranty information
- 20 C. Where a submittal includes material samples (carpet, tile, paint draw downs, etc.) the contractor shall do the
- 21 following:
- 22 1. The Contractor shall submit the sample(s) as indicated in the specification.
- 23 2. The Contractor shall include a quality photograph(s) of the product with the digital submittal.
- 24 Photographs shall meet the following requirements:
- 25 a. Formatted to be between 500Kb and 1.0 Mb in file size
- 26 b. Have no glare or flash reflection on the sample
- 27 c. Sample fills the frame of the photo and shows detail as needed. Include multiple photos from
- 28 other angles as needed.
- 29 d. Scanned copies of products or photos are not acceptable.
- 30 D. Uploaded submittals should be relative and related to a specific written specification.
- 31 1. Do not upload submittals under a broad category or division (I.E. HVAC 23 00 00). Always upload by the
- 32 specific specification that identifies a required product or performance to be met.
- 33 2. Group related items together if the specification is written that way. (I.E. all of the plumbing fixtures and
- 34 trim relative to one specific specification should be submitted together).
- 35 3. Submittals shall be grouped and adhere to the divisions in the submittal schedule. Submittals that do not
- 36 conform to the submittal schedule and/or specification divisions will be rejected for re-submittal.

37
38 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

39
40 **PART 3 - EXECUTION**

41
42 **3.1. GENERAL CONTRACTORS PROCEDURES**

- 43 A. All required submittals will be uploaded to the Construction Administration-Submittal Drawings Library on the
- 44 Project Management Web Site (PMWS) by the GC.
- 45 1. The GC shall open a new Submittal Form in the Submittals Drawings Library for each required submittal
- 46 from the Submittals schedule.
- 47 2. Fill in required information on the form that will be used for routing the review and comments.
- 48 3. Attach all documentation as described in Section 1.3 above.
- 49 a. Submit samples under separate cover to the Project Architect when necessary.
- 50 B. Uploading the submittal indicates that the GC has reviewed and approved the submittal against the contract
- 51 document requirements.
- 52 C. The GC shall discuss submittal status at all progress meetings and shall monitor submittal review/approval/re-
- 53 submittal so as to not incur delays in the project schedule.
- 54 D. A completed upload of the submittal to the PMWS initiates the review process workflow.
- 55 E. The GC and sub-contractors shall provide re-submittals as required.
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3.2. SUBMITTAL REVIEW

- A. Upon completion of the submittal upload by the GC the PMWS automatically notifies the appropriate Architect/Engineer and Owner Representative by Division/Specification number that there is a submittal for review.
- B. The submittal shall be reviewed internally by the required Architect/Engineer and Owner Representative in a timely fashion and provide commentary on missing items, incorrect information, or incomplete shop drawings, etc as needed.
- C. When the internal review is completed the PMWS will notify the Project Architect the submittal is ready for final review.

3.3. PROJECT ARCHITECTS REVIEW

- A. Upon completion of the internal review the Project Architect shall review all internal review comments, confer with the CPM as needed and determine the appropriate disposition status for the submittal (approved or resubmit).
- C. The Project Architect shall summarize final internal review comments onto the submittal cover sheet, provide a final disposition of the submittal and update the review status of the submittal to "Complete..." (with or w/o comments) or "Rejected".
- D. A completed Final Review status initiates the PMWS to notify the GC and appropriate sub-contractor(s) that the review of the submittal has been completed.

END OF SECTION

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SECTION 01 45 16
FIELD QUALITY CONTROL PROCEDURES

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16 3.5. CONSTRUCTION CLOSEOUT 3
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PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The City of Madison has developed a multi-faceted Quality Management Program that begins with contract
22 signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are
23 delivered for the contracted Work.
24 1. The Progress Management Web Site is a Construction Management tool that provides contractors and
25 staff a single on-line location for the daily operations and progression of the Work.
26 2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it
27 progresses. The City of Madison does not use a “Punch List” or “Corrections List” as it is typically known
28 throughout the construction industry. The QMO process acts as an “in progress punch list”.
29 a. By using the QMO process the City of Madison’s goal is to have a zero item punch list prior to the
30 90% progress payment and owner occupancy.
31 B. All contractors shall be required to review the specifications identified in Section 1.2 below, and other related
32 specifications identified therein to become familiar with the terminology and expectations of this City of
33 Madison Public Works contract.
34 C. It is the intent of this specification to outline the requirements, expectations, and responsibilities of the General
35 Contractor (GC), Project Architect, and other representatives of the Owner for items of Quality Assurance and
36 Quality Control.
37 1. This specification is not intended to conflict with Specification 01 40 00 Quality Requirements or other
38 specifications requiring testing and inspecting services.
39 2. This specification does not relieve the GC from any requirements associated with regulatory inspections
40 performed by the City of Madison Building Inspection Unit, or inspectors from other agencies as required
41 by code.
42 3. Any testing performed by an Owner’s Representative does not relieve the GC from performing any
43 testing that may be required by the construction documents.
44

1.2. RELATED SPECIFICATION SECTIONS

- 46 A. Section 01 26 13 Request for Information (RFI)
47 B. Section 01 29 76 Progress Payment Procedures
48 C. Section 01 31 13 Project Coordination
49 D. Section 01 31 23 Project Management Web Site
50 E. Section 01 40 00 Quality Requirements
51 F. Section 01 77 00 Closeout Procedures
52 G. Section 01 78 13 Completion and Correction List
53 H. Section 01 91 00 Commissioning
54

1.3. PERFORMANCE REQUIREMENTS

- 56 A. All contractors shall be responsible for a proper quality assurance/quality control (QA/QC) program throughout
57 the execution of the Work defined within the construction documents, including all recognized construction
58 industry standards and all applicable regulatory codes.

- 1 B. The GC shall be responsible for all of the following:
- 2 1. Monitor the quality of all workmanship, supplies, materials, and products being installed by all
- 3 contractors and installers to ensure they meet or exceed the minimum requirements set forth by the
- 4 construction documents.
- 5 2. Submit a Request for Information (RFI) whenever manufacturers' instructions or referenced standards
- 6 conflict with the construction documents before proceeding with the Work.
- 7 3. Ensure that Work requiring special certifications or licensing is being performed by is being performed
- 8 and supervised by personnel that meet the appropriate requirements.
- 9 a. Ensure that all certificates and licenses are current throughout the execution of the project.
- 10 C. The CoM and its representatives shall perform quality assurance and quality control activities throughout the
- 11 execution of this project. This in no way relieves the GC of maintaining an acceptable QA/QC program. =
- 12

13 **1.4. QUALITY ASSURANCE**

- 14 A. The GC shall be responsible for the following:
- 15 1. All materials, equipment, and products shall be new, clean, undamaged, and meet the performance
- 16 specifications defined within the construction documents including favorably reviewed submittals.
- 17 a. Any material, equipment, or product that does not meet the requirements of the construction
- 18 documents shall be removed and replaced, including any adjacent and related work, at the GCs
- 19 expense.
- 20 2. All Work shall be performed by persons properly trained and/or qualified to produce workmanship of the
- 21 quality specified in the construction documents.
- 22 3. Providing access to updated as-builts, addenda, submittals, bulletins and other related construction
- 23 documents at the project site.
- 24 B. The CoM and its representatives may be responsible for any of the following:
- 25 1. Attend pre-installation meetings
- 26 2. Attend construction progress meetings
- 27 3. Review all submittals
- 28 4. Conduct field visits for QA/QC purposes, provide feedback to the GC and sub-contractors using Quality
- 29 Management Observation (QMO) reports.
- 30 5. Review delivered equipment
- 31 6. Witness equipment installations, startups, testing as specified in other specifications
- 32

33 **1.5. QUALITY MANAGEMENT OBSERVATION REPORT**

- 34 A. The Quality Management Observation report or QMO is used as a QA/QC tool by those entities responsible for
- 35 QA/QC activities, including but not limited to, the GC, CoM, Project Architect (PA)/Project Engineer (PE), CX
- 36 agent, etc.
- 37 B. QMOs are designed to be an early observation of non-conforming construction work before it becomes buried
- 38 by follow on work. As such it is most often used as an "in progress punch list".
- 39 C. QMO forms are part of the Quality Control Library on the Project Management Web Site.
- 40

41 **PART 2 – PRODUCTS - THIS SECTION NOT USED**

42

43 **PART 3 - EXECUTION**

44

45 **3.1. QUALITY MANAGEMENT RESPONSIBILITIES**

- 46 A. While making routine progress visits to the construction project the GC, CPM, CxA and A/E, and applicable others
- 47 shall observe the details of the construction and installations to ensure that the intent of the construction
- 48 documents is being followed.
- 49 B. If during the progress visit there is a determination of contract non-conformance a QMO report shall be initiated
- 50 to begin the documentation process.
- 51 1. The GC field superintendent shall be informed immediately of any issue that may cause harm, damage to
- 52 finished work, or be buried prior to properly filing a QMO report.
- 53 C. The following information when filing a QMO report:
- 54 1. Open a QMO report in the Quality Control Library on the Project Management Web Site
- 55 2. Enter the date and time of the field visit
- 56 2. Provide references to construction documents if any (examples; specification, drawing page, details,
- 57 approved submittals, RFI, CB, etc)
- 58 3. Provide a short title for the observation being made

- 1 4. Provide a detailed description of the observation being made
- 2 5. Select all categories (Sitework, Structure, Enclosure, Interior, etc) from the given list that may apply to
- 3 the observation being reported.
- 4 a. For each category selected additional boxes shall open with contractor names associated with
- 5 each category.
- 6 6. Select all contractors from the lists provided that may need to be aware of the observation.
- 7 7. Provide any attachments that may help provide reference to the observation.
- 8 8. Click the SAVE button before closing the form.
- 9 D. The software for the Project Management Website will email notifications that a QMO report has been initiated.
- 10 The software will automatically select and notify the following:
- 11 1. The GC, PA/PE, and CPM for all observation reports being filed.
- 12 2. Others depending on the observation categories selected.
- 13 3. Contractors based on the selections made in the sub-contractors lists.

14
15 **3.2. RESPONDING TO A QMO**

- 16 A. All contractors receiving email notification of a QMO Observation shall review the details of the observation.
- 17 B. The GC shall be responsible for determining the course of action required to remedy the non-conforming issue
- 18 and shall coordinate and direct the contractor(s) responsible for any work related to the observation.
- 19 C. All contractors assigned to remedy the observation by the GC shall provide follow-up responses on the QMO
- 20 report as follows:
- 21 1. Open the QMO report in the Quality Control Library on the Project Management Web Site.
- 22 2. In the "Follow-Up Response" area enter a description of your follow-up response in the box provided.
- 23 a. Click "Insert Item" if additional boxes are required.
- 24 3. Add attachments (pictures) if needed to show the work has been completed.
- 25 4. Click the SAVE button before closing the form.

26
27 **3.3. GENERAL CONTRACTORS FOLLOW-UP**

- 28 A. The GC shall inspect the work to ensure that all assigned contractors have remedied the observation to the
- 29 intent of the construction documents.
- 30 B. The GC shall respond with any additional comments in their response box.
- 31 1. If no comments are to be made the GC at a minimum must date the response box to trigger the next
- 32 work flow.
- 33 C. Click the SAVE button before closing the form.
- 34 D. The software will email a notification to the CPM and the person who initiated the QMO that the issue has been
- 35 remedied.

36
37 **3.4. QMO CLOSEOUT PROCEDURE**

- 38 A. The person who initiated the QMO shall review the remedied work and if properly corrected shall close and date
- 39 the QMO form.
- 40 1. Click SAVE and the software will email a notification to the CPM that final review of the Observation is
- 41 required.
- 42 2. In the event there are still issues the Quality Manager can add additional comments in the response area,
- 43 click SAVE and re-issue the QMO for additional review as needed.
- 44 B. Once the person who initiated the QMO has closed the item the CPM shall review and verify with the PA/PE that
- 45 the Observation has been properly remedied and provide final closure on the QMO.

46
47 **3.5. CONSTRUCTION CLOSEOUT**

- 48 A. The GC shall note that successful close out QMOs are required for construction closeout as follows:
- 49 1. Certain progress payments as identified in Specification 01 29 76 are contingent QMO reports being properly
- 50 closed out.
- 51 2. Specification 01 77 00 defines all construction closeout requirements.

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55 **END OF SECTION**

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SECTION 01 45 29
TESTING LABORATORY SERVICES

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PART 1 – GENERAL

1.1. REQUIREMENTS INCLUDED

- 18 A. The Contractor shall employ and pay for the services of an independent testing laboratory to perform specified
19 services and testing.
20 B. Testing Laboratory inspection, sampling and testing is required for:
21 1. Section 03 30 00: Cast-In-Place Concrete
22 2. Section 05 12 00: Structural Steel Framing
23 3. Section 05 40 00: Cold-Formed Steel Framing
24 4. Section 31 20 00: Earthwork
25

1.2. RELATED REQUIREMENTS

- 27 A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or
28 approvals of public authorities.
29 B. Related Requirements Specified in Other Sections:
30 1. Division 22 and 23: Testing of Mechanical Systems
31 2. Division 26: Testing of Electrical Systems
32

1.3. QUALIFICATION OF LABORATORY

- 34 A. Meet “Recommended Requirements of Independent Laboratory Qualification” published by American Council of
35 Independent Laboratories.
36 B. Meet basic requirements of ASTM E 329, “Standards of Recommended Practice for Inspection and Testing
37 Agencies for Concrete and Steel as Used in Construction.”
38 C. Authorized to operate in State in which the Project is located.
39

1.4. LABORATORY DUTIES

- 41 A. Cooperate with Owner, A/E and Contractor; provide qualified personnel after due notice.
42 B. Perform specified inspections, sampling and testing of materials and methods of construction:
43 1. Comply with specified standards.
44 2. Ascertain compliance of materials with requirements of Contract Documents.
45 C. Promptly notify the Owner, A/E and Contractor of observed irregularities or deficiencies of work or products.
46 D. Promptly submit written report of each test and inspection; one copy each to A/E, Consulting Engineer, Owner
47 and Contractor. Each report shall include:
48 1. Date issued.
49 2. Project Title and number.
50 3. Testing laboratory name, address and telephone number.
51 4. Name and signature of laboratory inspector.
52 5. Date and time of sampling or inspection.
53 6. Record of temperature and weather conditions.
54 7. Date of test.
55 8. Identification of product and specification section.
56 9. Location of sample or test in the Project.
57 10. Type of inspection or test.
58 11. Results of tests and compliance with Contract Documents.

- 1 12. Interpretation of test results, when requested by A/E or the Contractor.
- 2 E. Perform additional tests as required by Owner, A/E or the Contractor.
- 3
- 4 **1.5. LIMITATIONS OF AUTHORITY OF TESTING LABORATORY**
- 5 A. Laboratory is not authorized to:
 - 6 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 7 2. Approve or accept any portions of the Work other than those portions of the Work scheduled for testing.
 - 8 3. Perform any duties of the Contractor.
 - 9
- 10 **1.6. CONTRACTOR'S RESPONSIBILITIES**
- 11 A. Cooperate with laboratory personnel, provide access to Work and to manufacturer's operations.
- 12 B. Secure and deliver to the laboratory, adequate quantities of representative samples of materials proposed to be used and which require testing. Submit concrete mix designs to A/E for approval prior to pouring concrete.
- 13 C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes that require control by the testing laboratory.
- 14 D. Furnish copies of Product test reports as required.
- 15 E. Furnish incidental labor and facilities:
 - 16 1. To provide access to Work to be tested.
 - 17 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
 - 18 3. To facilitate inspections and tests.
 - 19 4. For storage and curing of test samples.
- 20 F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
- 21 G. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience.
- 22 H. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required when initial tests indicate work does not comply with Contract Documents.
- 23 I. Temporarily halt the progress of the Work when tested materials do not comply with Contract Documents and promptly notify the Owner or their designated representative and A/E.
- 24 J. Remove and replace at no cost to the Owner, all defective materials discovered upon testing not to comply with Contract Documents, including cost for retesting and re-inspecting replaced Work that failed to comply with the Contract Documents.
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- 35 **1.7. SPECIFIC TEST, INSPECTIONS, AND METHODS REQUIRED**
- 36 A. **Section 03 30 00: Cast-In-Place Concrete**
 - 37 1. Secure sample of aggregates Contractor proposes to use and test for compliance with Specifications.
 - 38 2. Certify compliance with Specifications of cement proposed for use by the Contractor.
 - 39 3. Review and approve the Contractor's proposed concrete mix proportions for the required concrete strengths using materials Contractor proposed to use on the project. Incorporate specified admixtures and not less than amounts of cement specified.
 - 40 4. Perform appropriate laboratory tests, including compression tests of cylinders and slump test to substantiate mix designs.
 - 41 5. Inspect and test materials during concrete work to substantiate compliance with Specifications and mix requirements.
 - 42 a. Testing:
 - 43 i. Sample and test concrete in accordance with ASTM C 31, ASTM C 143, ASTM C 172, and ASTM C 231.
 - 44 ii. Perform slump tests in accord with ASTM C 143 from same concrete batch used for test cylinders and record results and comments on compression test reports.
 - 45 iii. Perform compression tests in accordance with ASTM C39.
 - 46 iv. When air-entrained concrete is used, a minimum of one (1) air content test shall be performed in accordance with ASTM C 231 for each set of test cylinders taken.
 - 47 v. Identify all test cylinders with symbols to indicate location on the job where concrete test was made. Record on project record drawings.
 - 48 vi. Strength tests shall be made for: each day's pour; each class of concrete; each change of supplies or sources; and for each 100 cubic yards of concrete or fraction thereof.
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- 1 vii. One slump test shall be made for each set of test cylinders taken following the procedure
2 in ASTM C 143.
- 3 b. Test Cylinders for all Concrete
- 4 i. Each test shall consist of a minimum of four cylinders.
- 5 ii. Make test cylinders in conformity with ASTM C 31.
- 6 iii. After 24 hours three cylinders to be carefully transported to the testing laboratory for
7 moisture curing and one cylinder to be field cured.
- 8 iv. One field cured cylinder to be tested at 7 days and two laboratory cured cylinders to be
9 tested at 28 days. Reserve one cylinder for further testing.
- 10 v. The average of all strength tests representing each class of concrete, as well as the average of
11 any three consecutive strength tests for each class of concrete, shall be equal to or
12 greater than the specified strength.
- 13 vi. If the A/E has reason to believe that cylinder strength tests are not representative of the
14 strength of concrete in place, A/E shall require drilled cores to be cut and tested at the
15 Contractor's expense. Coring and testing shall be in accordance with ASTM C 42 Standard
16 Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- 17 B. **Section 05 12 00: Structural Steel Framing**
- 18 1. Welding:
- 19 a. Provide inspection of shop and field welding in accordance with Section 6 of AWS D1.1.
- 20 b. Visually inspect all welds, perform appropriate non-destructive tests on apparent defective welds.
21 Verify conformance with Specifications.
- 22 c. Non-destructive testing shall be performed on 20 percent of the total length of all full penetration
23 welds. If a sufficient number of welds are deficient, additional testing may be performed at the
24 discretion of the testing lab, at no cost to Owner.
- 25 2. Bolting:
- 26 a. Visually inspect all connections for proper number, size and type of bolt.
- 27 b. Review all bolted connections for compliance with "snug tight" requirements of AISC.
- 28 c. No Slip-critical (SC) connections/bolts are required for this project.
- 29 d. Shear Connectors, Headed/Deformed Bar Concrete Anchors:
- 30 i. Verify pre-production test records for installation of shear connectors, concrete anchors
31 and threaded studs.
- 32 ii. Shear connectors shall be struck with a hammer. Those not producing a "clean" pinging
33 sound indicative of a fully attached shear connector shall be bent 15 degrees off vertical
34 towards the nearest support by striking with a hammer. If shear connector does not
35 become loose and weld is not broken, it shall be considered acceptable, and shall be left in
36 the bent position. Replace failing shear connectors and test as before.
- 37 iii. A visual inspection shall be made of shear connectors and headed/deformed bar concrete
38 anchors after installation. If visual inspection reveals that a sound weld and a 360 degree
39 flash has not been obtained, the connector/anchor shall also be tested by bending a
40 minimum of 15 degrees off vertical opposite to the missing weld/flash, irrespective of the
41 results of the "ping" test required for shear connectors. If the connector/anchor does not
42 become loose it shall be considered acceptable and shall be left in this position. Replace
43 failing connector/anchors and inspect as before.
- 44 C. **Section 05 40 00: Cold Formed Steel Framing**
- 45 1. As directed by A/E, Contractor's testing agency may inspect the maintenance of a quality control program
46 including spot checking weldments and welding procedures in accordance with AWS standards.
- 47 D. **Section 31 20 00: Soil Compaction Control and Trenching and Backfilling**
- 48 1. Soils Engineer to be onsite during excavation operation.
- 49 2. Visually inspect, test, and certify that exposed undisturbed underlying soil is suitable for required footing
50 bearing capacity and placement of fills.
- 51 3. Maximum and minimum density of fill soil for compaction percentage of relative density and moisture
52 density shall be determined in accordance with ASTM Designation D 1557. Testing agency will test
53 compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937,
54 as applicable.
- 55 4. Number of tests as follows:
- 56 a. Subgrade, Undisturbed and Demolition Surfaces: Visual inspection and probe; test if required.
- 57 b. Interior Fills: One test per 2,500 sq. ft for each two foot or less lift.
- 58 c. Exterior Fills: One test per 2,500 sq. ft for each two foot or less lift.

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d. Utility Trenches: One test per 50 lineal feet for each two foot or less lift.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

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PART 1 – GENERAL

1.1. SUMMARY

- A. This Section includes general procedural requirements for temporary facilities and controls including, but not limited to the following:
1. Temporary Utilities
 2. Telecommunications Services
 3. Temporary Sanitary Facilities
 4. Barriers
 5. Fencing
 6. Exterior Enclosures
 7. Security
 8. Vehicular Access and Parking
 6. Waste Removal
 7. Project Identification
 8. Field Offices

1.2. RELATED SPECIFICATION SECTIONS

- A. Section 01 31 19 Progress Meetings
- B. Section 01 31 23 Project Management Web Site
- C. Section 01 74 19 Construction Waste Management and Disposal

1.3. QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:
1. Building Code requirements
 2. Health and safety regulations
 3. Utility company regulations
 4. Police, Fire Department and Rescue Squad rules
 5. Environmental protection regulations
 6. Joint Commission - Hospital Accreditation Standards

- 1 B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition
- 2 Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA
- 3 Electrical Design Library "Temporary Electrical Facilities".
- 4 C. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service.
- 5 Install service in compliance with NFPA 70 "National Electric Code".
- 6

7 **1.4. TEMPORARY UTILITIES**

- 8 A. Owner will provide the following:
 - 9 1. Electrical power and metering, consisting of existing facilities.
 - 10 2. Water supply, consisting of existing facilities.
- 11 B. General:
 - 12 1. Existing facilities may be used.
 - 13 2. New permanent facilities may be used.
- 14 C. Water Service: Water is available from existing building services.
 - 15 1. Use trigger-operated nozzles for water hoses, to avoid waste of water.
- 16 D. Temporary Electric Power Service: Electrical Contractor shall extend temporary power from existing building
- 17 services.
- 18 E. Temporary Lighting: Electrical Contractor shall provide temporary lighting with local switching
 - 19 1. Install and operate temporary lighting, minimum of 30 fc, to fulfill security and protection requirements,
 - 20 without operating the entire system, and will provide adequate illumination for all areas of work,
 - 21 including construction operations and traffic conditions.
- 22 F. Temporary Heat: General Contractor shall provide temporary heat required by construction activities, for curing
- 23 or drying of completed installations or protection of installed construction from adverse effects of low
- 24 temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed
- 25 installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition
- 26 required and minimize consumption of energy.
 - 27 1. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-
 - 28 contained LP gas or fuel oil heaters with individual space thermostatic control.
 - 29 a. Use of gasoline-burning space heaters, open flame, or salamander type heating units is
 - 30 prohibited.
- 31

32 **1.5. TELECOMMUNICATIONS SERVICES AND WI-FI**

- 33 A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization through
- 34 construction closeout.
- 35 B. Telecommunications services shall include:
 - 36 1. Windows-based personal computer dedicated to project telecommunications.
 - 37 2. Shared access to the internet via WIFI or similar wireless connection.
 - 38 a. Access must be capable to support minimum of 10 wireless devices.
 - 39 3. Email Account/address dedicated for GC Project Manager of GC Supervisor on site.
- 40

41 **1.6. TEMPORARY SANITARY FACILITIES**

- 42 A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- 43 B. Temporary toilets: Comply with regulations and health codes for the type, number, location, operation, and
- 44 maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
 - 45 1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide
 - 46 covered waste containers for used material.
 - 47 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
- 48 C. Maintain daily in clean and sanitary condition
- 49 D. Water: Provide potable water approved by local health authorities
- 50

51 **1.7. BARRIERS**

- 52 A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be
- 53 hazardous to workers or the public or City staff and to protect existing facilities and adjacent properties from
- 54 damage from construction operations and demolition.
- 55

56 **1.8. FENCING**

- 57 A. Construction: Refer to Plan Documents and Specification Section 01 76 00: Fencing Materials and Barricades
- 58

1 **1.9. EXTERIOR ENCLOSURES**

- 2 A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions
3 and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures
4 identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors
5 with self-closing hardware and locks.
6

7 **1.10. SECURITY**

- 8 A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized
9 entry, vandalism, or theft.
10

11 **1.11. VEHICULAR ACCESS AND PARKING**

- 12 A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for
13 emergency vehicles.
14 B. Coordinate access and haul routes with governing authorities and Owner.
15 C. Provide and maintain access to fire hydrants, free of obstructions.
16 D. Existing employee parking areas located at 3829 Hanson Rd may be used for construction personnel parking until
17 the Metro Transit Hanson Rd Satellite Bus Facility Remodel is occupied by Owner.
18

19 **1.12. WASTE REMOVAL**

- 20 A. See Section 01 74 19 - Waste Management, for additional requirements.
21 B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
22 C. Provide containers with lids. Remove trash from site periodically.
23 D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible
24 containers; locate containers holding flammable material outside the structure unless otherwise approved by the
25 authorities having jurisdiction.
26 E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.
27

28 **1.13. PROJECT IDENTIFICATION**

- 29 A. Provide project identification sign of design and construction indicated in Section 01 58 13.
30 B. Erect on site at location determined by Owner .
31 C. No other signs are allowed without Owner permission except those required by law.
32

33 **1.14. FIELD OFFICES**

- 34 A. Office: Weather tight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy
35 furniture, drawing rack and drawing display table.
36 B. Field Office shall be located within the project site.
37 C. Provide space for Project Meetings with table and chairs to accommodate a minimum of fifteen (15) persons.
38 D. Provide a minimum of a 40" LCD monitor or other digital projection device to be connected to the computer
39 identified in Section 1.5 Telecommunications Services (above), for use during progress meetings in connection
40 with reviewing construction progress information posted to the Project Management Web Site (Specification 01
41 31 23) hosted by the Owner.
42

43 **PART 2 - PRODUCTS**

44
45 **2.1. TEMPORARY PARTITIONS**

- 46 A. Provide dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and
47 noise.
48 1. Non-fire rated partitions, standard
49 a. Wood stud framing, 6-mil polyethylene
50

51 **2.2. EQUIPMENT**

- 52 A. Temporary Lifts and Hoists: Contractors requiring temporary lifts and hoists shall provide facilities for hoisting
53 materials and employees.
54 B. Electrical Outlets: Electrical Contractor shall provide properly configured NEMA polarized outlets to prevent
55 insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault
56 circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
57 C. Electrical Power Cords: Contractors requiring power cords shall provide grounded extension cords; use "hard-
58 service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate

- 1 lengths of electric cords, if single lengths will not reach areas where construction activities are in progress. Do
2 not exceed safe length-voltage ratio.
- 3 D. Lamps and Light Fixtures: Electrical Contractor shall provide general service incandescent lamps of wattage
4 required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to
5 breakage. Provide exterior fixtures where exposed to moisture.
- 6 E. Heating Units: General Contractor shall provide temporary heating units that have been tested and labeled by
7 UL, FM or another recognized trade association related to the type of fuel being consumed.
- 8 F. First Aid Supplies: General Contractor shall provide first aid supplies complying with governing regulations.
- 9 G. Fire Extinguishers: General Contractor shall provide hand-carried, portable UL-rated, fire extinguishers of NFPA
10 recommended classes for the exposures, extinguishing agent and size required by location and class of fire
11 exposure.

12
13 **PART 3 - EXECUTION**

14
15 **3.1. TEMPORARY FIRE PROTECTION**

- 16 A. Until fire protection needs are supplied by permanent facilities, General Contractor shall install and maintain
17 temporary fire protection facilities of the types needed to protect against reasonably predictable and
18 controllable fire losses.
- 19 B. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding
20 Construction, Alterations and Demolition Operations".
- 21 C. Locate fire extinguishers where convenient and effective for their intended purpose.
- 22 D. Store combustible materials in containers in fire-safe locations.
- 23 E. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways
24 and other access routes for fighting fires.
- 25 F. Prohibit smoking on the premises.
- 26 G. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition
27 according to requirements of authorities having jurisdiction.
- 28 H. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site
- 29 I. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods
30 and procedures. Post warnings and information.

31
32 **3.2. COLLECTION AND DISPOSAL OF WASTE**

- 33 A. Collect waste from construction areas and elsewhere daily
- 34 B. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce
35 requirements strictly.
- 36 C. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to
37 rise above 80 deg F.
- 38 D. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing
39 properly. Dispose of material in a lawful manner.

40
41 **3.3. ENVIRONMENTAL PROTECTION**

- 42 A. Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply
43 with environmental regulations, and minimize the possibility that air, waterways and subsoil might be
44 contaminated or polluted, or that other undesirable effects might result.
- 45 B. Avoid use of tools and equipment which produce harmful noise.
- 46 C. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms
47 near the site.

48
49 **3.4. REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS**

- 50 A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion inspection.
- 51 B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- 52 C. Clean and repair damage caused by installation or use of temporary work.
- 53 D. Restore existing facilities used during construction to original condition.
- 54 E. Restore new permanent facilities used during construction to specified condition.

55
56
57
58 **END OF SECTION**

SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE

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14

PART 1 – GENERAL

1.1. SECTION INCLUDES

- A. Project identification sign.

1.2. QUALITY ASSURANCE

- A. Design sign and structure to withstand 50 miles/hr wind velocity.
B. Sign Painter: Experienced as a professional sign painter for minimum three years.
C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.3. SUBMITTALS

- A. See Section 01 30 00 – Administrative Requirements for submittal procedures.
B. Shop Drawing: Show content, layout, lettering, color, structure, sizes.

PART 2 - PRODUCTS

2.1. SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4" thick, standard large sizes to minimize joints.
C. Rough Hardware: Galvanized

2.2. PROJECT IDENTIFICATION SIGN

- A. One painted sign, 32 sq ft area, bottom 6 feet above ground.
B. Content:
1. Project title, City of Madison, Metro Transit logo and name of Owner as indicated on Contract Documents.
2. Names and title of Architect.
3. Name of Prime Contractor.
4. Full color project rendering from high resolution image as furnished by Architect.

PART 3 - EXECUTION

3.1. INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
B. Erect at designated location.
C. Install sign surface plumb and level, with butt joints. Anchor securely.

3.2. REMOVAL

- A. Remove sign, framing supports, and foundations at completion of Project and restore the area.

END OF SECTION

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**SECTION 01 60 00
PRODUCT REQUIREMENTS**

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18

PART 1 – GENERAL

1.1. SUMMARY

- 19
20
21
22 A. The purpose of this specification is to provide general guidelines and responsibilities related to the receiving,
23 handling, and storage of all materials and products from arrival on the job site through installation.
24 1. Immediate inspection of delivered goods means a timely replacement if damaged.
25 2. Proper storage helps prevent damage and loss by weather, vandalism, theft, and job site accidents.
26 3. Proper storage helps with job site performance and safety.
27 2. Proper handling helps prevent damage and job site accidents.
28 B. Each Contractor shall be directly responsible for the receiving, handling, and storage of all materials and
29 products associated with the Work of their Division or Trade.
30 C. Each Contractor responsible for Work associated with Owner provided materials or products shall be responsible
31 for the receiving, handling and storage of the material/product as outlined in Section 3.8 below..
32

1.2. RELATED SPECIFICATIONS

- 33
34 A. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
35 Works Construction”.
36 1. Use the following link to access the Standard Specifications web page:
37 <http://www.cityofmadison.com/business/pw/specs.cfm>
38 a. Click on the “Part” chapter identified in the specification text. For example if the specification
39 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
40 PDF will open.
41 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
42 to the referenced text.
43 c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.
44 B. Section 01 57 21 Indoor Air Quality
45 C. Section 01 74 13 Progress Cleaning
46 D. Section 01 76 00 Protecting Installed Construction
47 E. Other Divisions and Specifications that may address more specifically the requirements for the storage and
48 handling of materials and products associated Work of other Divisions or Trades.
49

1.3. QUALITY ASSURANCE

- 50
51 A. The GC shall be responsible for ensuring that these minimum storage and handling requirements are met by all
52 contractors on the project site including but not limited to the following:
53 1. Receiving deliveries of materials, products, and equipment.
54 a. Inspect all deliveries upon arrival for damage, completeness, and compliance with the
55 construction documents.
56 i. Deliveries shall remain in original packaging or crates, shipping manifest shall be kept with
57 the delivery and the packaging shall have visible identification of the items within the
58 packaging.

- 1 b. Immediately report any damaged products or equipment to the GC, begin arrangements for
2 immediate replacement.
- 3 c. Materials or equipment that have been damaged, are incomplete, or do not comply with the
4 construction documents shall not be permitted to be installed.
- 5 2. All materials and products shall be stored within the designated limits of the project site. Only store the
6 amount of material necessary for upcoming operations so as not to interfere with other construction
7 activities and access to Work by the Owner and Architect. Any offsite storage shall be at the expense of
8 the contractor storing the material or product. All offsite storage requirements shall comply with this
9 specification. All offsite storage of materials is subject to Owner Representative Quality Management
10 review at any time.
- 11 3. Large storage containers may be used but shall be weather tight, securable, placed on concrete blocks,
12 timbers, or jack stands and shall be level.
- 13 4. When lifting equipment is required the equipment rating shall be greater than the loading requirements
14 of the item being lifted. In addition all of the following shall apply as necessary:
- 15 a. Only designated and/or designed lift points shall be used.
- 16 b. Large items shall have tag lines and handlers at all times during lifting operations.
- 17 c. Lift at multiple points as needed to prevent bending.
- 18 5. Materials and products stored inside of the structure shall comply with all of the following:
- 19 a. Storage shall not be allowed to impede the flow of work in progress.
- 20 b. Storage shall not be allowed to hide completed work from review and inspections.
- 21 c. Storage shall not exceed the design loads of the structural components it is being stored upon.
- 22 6. All materials and products shall be stored according the manufacturers minimum recommended
23 requirements. All of the following shall be considered before storing any product or material:
- 24 a. Dust and dirt
- 25 b. Moisture and humidity, including rain and snow
- 26 c. Excessive temperatures, direct sun, etc
- 27 d. Product or material weight and size
- 28 e. Potential for breakage
- 29 f. Product incompatibility with other products such as corrosiveness, chemical reactions,
30 flammability, etc.
- 31 g. Product or material value and replacement cost
- 32 7. The Contractor shall be responsible for providing fully functional tarps or plastic wrap, to protect
33 materials and products from the weather. All coverings shall be free of large holes and tears, and shall be
34 tied, strapped, or weighted down to resist blowing.
- 35 8. The Contractor shall be responsible for any temporary heating, cooling, or other utility requirement that
36 may be associated with the storage of a material or product.
- 37 9. The Contractor shall be responsible for securing materials and products of value such as copper, A/V
38 equipment, etc. Such items shall be stored in securable shipping containers, job trailers or other such
39 storage devices. Container shall be kept secured when not in use.
- 40 B. The GC shall inspect the job site daily to ensure that all products and materials stay weather tight and are
41 secured against vandalism or theft as required by this specification.
- 42 C. The Owners Representative may at any time request improvements regarding storage of any material or product
43 being provided under these construction documents.
- 44

45 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

46

47 **PART 3 - EXECUTION**

48

49 **3.1. GENERAL CONTRACTOR REQUIREMENTS**

- 50 A. Designate material storage and handling areas as needed including all of the following:
- 51 1. Designate specific areas of the site for delivery and storage of materials to be used during the execution
52 of the Work.
- 53 2. Designated areas shall not be located so as to interfere with the installation of any Work including Work
54 by others such as the installation of utilities or the maintenance of existing utilities. This shall include not
55 storing items in active utility easements as designated by the site plan.
- 56 B. Arrange for openings in the building as needed to allow delivery and installation of large items. Openings shall
57 be appropriately sized to include the use of booms, slings, and other such lifting devices that may be larger than
58 the item being installed.

- 1 1. When openings are required in completed Work (new or existing) the GC shall be responsible for
2 providing an appropriate opening and for restoring the opening to the original or better condition upon
3 completion. Restoration shall be weather tight and complete.
4 C. Repeated moving and handling of items being stored shall not be allowed. The GC shall be responsible for any
5 damage and replacement because of mishandling or excessive handling.
6
7 **3.2. BULK MATERIAL**
8 A. Bulk material such as sand, gravel, top soil and other types of fill shall be stored away from the construction area
9 and shall be stock piled as follows:
10 1. All bulk material shall be piled safely and efficiently in as small an area as practical. Only store the
11 amount of material necessary for upcoming operations so as not to interfere with other construction
12 activities and access to Work by the Owner and Architect.
13 2. All stock piles shall have silt fence/sock properly installed around the perimeter to prevent erosion and
14 loss of material. Refer to City of Madison Standard Specification Section 210.1(f) and other related
15 specification or details.
16 3. Fine grained material shall be protected with tarps to prevent blowing. Tarps shall be weighted or staked
17 to stay in place.
18 B. Bulk material such as brick, concrete block, stone, and other palletized materials shall be stored on original
19 shipping pallets until ready for use.
20
21 **3.3. DRY PACKAGED MATERIAL**
22 A. Dry packaged material such as cement, mortar, etc shall be stored on pallets, on slightly elevated ground or clear
23 stone pad to keep water away from the base of the material being stored. Protect from moisture.
24
25 **3.4. STRUCTURAL AND FRAMING MATERIAL**
26 A. All structural and framing material shall be stored in an organized manner arranged by type, size and dimension.
27 Materials shall be stored on pallets or timbers as necessary and shall not be allowed to lie directly on the ground.
28 B. Long and heavy items shall be supported at several points to prevent bending and warping.
29
30 **3.5. EQUIPMENT**
31 A. Equipment delivered to the site shall be stored away from all construction activities until the item can either be
32 moved inside or properly installed.
33 B. Equipment shall be stored on slightly elevated ground or clear stone pad to keep water away from the base of
34 the equipment.
35
36 **3.6. FINISH PRODUCTS**
37 A. Finish products such as flooring, tile, counters, lockers, toilets, partitions, lighting, and other similar items should
38 not be delivered and stored until the structure has been enclosed, is weather tight, temperature controlled and
39 the contractor is ready for such items to be installed.
40 1. Storage of finished products outside for any length of time shall not be allowed.
41 B. Products that cannot be stored inside the structure shall be stored in secured containers or job trailers until such
42 time as they are ready to be installed.
43 C. Products with a high potential for breakage such as glass, mirrors, tiles, toilet fixtures, etc. shall be stored with
44 additional protection as necessary such as but not limited to the following:
45 1. Store in original shipping containers until ready for installation.
46 2. Do not store in high traffic areas.
47 3. Shield with other materials such as cardboard, plywood, or similar products.
48
49 **3.7. DUCTWORK, PIPING, AND CONDUIT**
50 A. All piping and conduit shall be stored horizontally unless otherwise specified by the manufacturer or Division and
51 Trade Specifications.
52 1. Do not store directly on grade.
53 2. Cover metal pipes and tubes to prevent rust and corrosion, allow ventilation to prevent condensation.
54 3. Whenever possible use pipe stands for storing pipe and conduit to prevent tripping and rolling hazards.
55 B. All ductwork shall be stored horizontally or vertically as necessary unless otherwise specified by the
56 manufacturer or Division and Trade Specifications.
57 1. During storage, both ends of each duct shall be protected with plastic sheathing to prevent dust and dirt
58 from getting inside the duct. Sheathing shall be sufficiently taped to the duct.

- 1 2. After installation, free/open ends shall remain protected with taped plastic sheathing and or temporary
2 filters as specified by division or Trade specifications.
3

4 **3.8. OWNER PROVIDED, CONTRACTOR INSTALLED EQUIPMENT**

5 A. Section 3.8.A. shall apply to all equipment being provided to any contractor directly from the Owner for
6 installation under the contract.

7 1. The Owner or Owners Representative shall do the following:

8 a. Inspect all deliveries upon receipt and notify manufacturer of any issues directly.

9 b. Review the received shipment with the contractor.

10 i. Only provide products or materials to the contractor that were not damaged through
11 shipping or handling.

12 ii. Confirm missing products or materials and anticipated delivery schedule if known.

13 2. The Contractor responsible for the installation of Work associated with Owner provided materials or
14 products shall “take ownership” and provide safe and secure storage and handling as previously
15 described within this specification.

16 i. The Contractor shall be liable for the repair or replacement of any material or product
17 damaged after taking ownership of the product from receipt through final acceptance.

18 B. Section 3.8.B. shall apply to all equipment being provided by the Owner but shipped directly to any sub-
19 contractor or the project site for installation under the contract.

20 1. The GC and/or Contractor responsible for the Work associated with the Owner provided materials or
21 products shall do the following:

22 a. Inspect all deliveries upon receipt and notify the Owner or Owners Representative of any issues
23 directly.

24 i. Owner or Owners Representative shall notify manufacturer of any issues directly.

25 b. Review the received shipment with the Owner or Owners Representative

26 i. Confirm missing products or materials and anticipated delivery schedule if known.

27 2. The Contractor shall “take ownership” and provide safe and secure storage and handling as previously
28 described within this specification.

29 i. The Contractor shall be liable for the repair or replacement of any material or product
30 damaged after taking ownership of the product from receipt through final acceptance.
31
32
33

34 **END OF SECTION**
35

**SECTION 01 71 23
FIELD ENGINEERING**

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PART 1 – GENERAL

1.1. REQUIREMENTS INCLUDED

- A. The Contractor shall provide and pay for field engineering services required for the Project:
1. Land surveying services required to execute the Work, to include building addition location and layout, and location and layout of pavements and all proposed site improvements.
 2. Verification of existing building dimensions, elevations, and relationship to proposed additions.
 3. Professional Engineering services to execute Contractor’s construction methods.
 4. Registered Professional Engineer in the State of Wisconsin to determine the load capacity of the existing structure for use of Contractors temporary facilities, equipment, lifts, machinery, material storage, etc.

1.2. RELATED REQUIREMENTS

- A. Conditions of the Contract

1.3. PROCEDURES

- A. A property survey has been prepared for the Owner and has been bound with Contract Drawings. Surveys shall describe physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. If information is incomplete, notify Owner to furnish additional information. Verify easement locations, front, side, and rear yard restrictions, if any; and property line locations. Verify control points, and establish bench marks. Locate and layout roads, walks, parking areas and all civil structures and all proposed site improvements.
- B. Verify locations of underground services, utilities, structures, etc. which may be encountered or affected by the Work.

1.4. PROJECT SURVEY REQUIREMENTS

- A. Using datum, the lot lines and present levels have been established as indicated on the Drawings. Other grades, lines, levels and benchmarks, shall be established and maintained by the Contractor, who shall be responsible for them. As work progresses, the Contractor shall layout on forms and floor, the locations of all partitions, walls and fix column centerlines as a guide to all trades. The Contractor shall make provision to preserve property line stakes, benchmarks, or datum point. If any are lost, displaced or disturbed through neglect of any Contractor, Contractor’s agents or employee, the Contractor responsible shall pay the cost of restoration.
- B. Establish lines and levels, locate and layout, by instrumentation and similar appropriate means, additions, column locations, floor levels, stakes for walks, etc.
- C. Provide data to all Subcontractors for their use as applicable.
- D. From time to time, verify layouts by same methods.

1.5. RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

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**SECTION 01 73 29
CUTTING AND PATCHING**

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PART 1 – GENERAL

1.1. SUMMARY

- 21 A. This Section includes general procedural requirements for cutting and patching including, but not limited to the
22 following:
23 1. Examination
24 2. Preparation
25 3. Performance
26 4. Cleanup and Restoration
27

1.2. RELATED SPECIFICATION SECTIONS

- 29 A. Divisions 02 through 32 Sections for specific requirements and limitations applicable to cutting and patching
30 individual parts of the Work.
31 B. Division 07 Section "Penetration Fire Stopping" for patching fire-rated construction.
32

1.3. DEFINITIONS

- 34 A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
35 B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other
36 Work.
37 C. Level Alpha
38

1.4. QUALITY ASSURANCE

- 40 A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying
41 capacity or load-deflection ratio.
42 B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results
43 in reducing their capacity to perform as intended or that may result in increased maintenance or decreased
44 operational life or safety.
45 C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that
46 could change their load-carrying capacity that results in reducing their capacity to perform as intended, or that
47 may result in increased maintenance or decreased operational life or safety. Some miscellaneous elements
48 include the following:
49 1. Water, moisture, or vapor barriers
50 2. Membranes and flashings
51 3. Exterior curtain-wall construction
52 4. Equipment supports
53 5. Piping, ductwork, vessels, and equipment
54 6. Noise and vibration control elements and systems
55 D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and
56 patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that
57 would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has
58 been cut and patched in a visually unsatisfactory manner.

1 **1.5. WARRANTY**

- 2 A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting
3 and patching operations, by methods and with materials so as not to void existing warranties.
4 B. All cutting and patching work performed under this contract shall be warranted like new work as defined by the
5 Specification governing the work.
6

7 **PART 2 - MATERIALS**

8
9 **2.1. GENERAL**

- 10 A. Comply with requirements specified within other sections of the Specifications.
11 B. In-Place Materials: Use materials identical to existing in-place materials. For exposed surfaces use materials that
12 visually match in-place adjacent surfaces to the fullest extent possible.
13 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the
14 visual and functional performance of in-place materials.
15

16 **PART 3 - EXECUTION**

17
18 **3.1. EXAMINATION**

- 19 A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
20 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including
21 compatibility with in-place finishes or primers.
22 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
23

24 **3.2. PREPARATION**

- 25 A. Temporary Support: Provide temporary support of Work to be cut.
26 B. Protection: Protect in-place construction and existing conditions during cutting and patching to prevent damage.
27 Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting
28 and patching operations. If the failure to protect, or the lack of protection, of in-place construction and/or
29 existing conditions results in damage, the contractor shall be responsible for repair to previous condition.
30 C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
31 D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be
32 removed, relocated, or abandoned, bypass such services/systems before cutting to eliminate interruption to
33 occupied areas.
34

35 **3.3. PERFORMANCE**

- 36 A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the
37 earliest feasible time, and complete without delay.
38 1. Cut in-place construction to provide for installation of other components or performance of other
39 construction, and subsequently patch as required to restore surfaces to their original condition.
40 B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations,
41 including excavation, using methods least likely to damage elements retained or adjoining construction. If
42 possible, review proposed procedures with original Installer; comply with original Installer's written
43 recommendations.
44 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and
45 chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance
46 of adjacent surfaces. Temporarily cover openings when not in use.
47 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
48 3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
49 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by
50 cutting and patching operations.
51 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap,
52 valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other
53 foreign matter after cutting.
54 6. Proceed with patching after construction operations requiring cutting are complete.
55 C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following
56 performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and
57 comply with installation requirements specified in other Sections.

- 1 D. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of
2 installation.
3

4 **3.4. CLEANUP AND RESTORATION**

- 5 A. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a
6 manner that will eliminate evidence of patching and refinishing.
7 1. Clean piping, conduit, and similar features before applying paint or other finishing materials.
8 2. Restore damaged pipe covering to its original condition.
9 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another,
10 patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish,
11 color, texture, and appearance. Remove in-place floor and wall coverings and replace with new
12 materials, if necessary, to achieve uniform color and appearance.
13 4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch
14 and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats
15 until patch blends with adjacent surfaces.
16 5. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of
17 uniform appearance.
18 6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight
19 condition.
20 7. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint,
21 mortar, oils, putty, and similar materials.
22 8. Any smoke and fire caulking that has been disturbed must be replaced by the Contractor as required by
23 code.
24
25
26
27
28

END OF SECTION

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**SECTION 01 74 13
PROGRESS CLEANING**

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16

PART 1 – GENERAL

1.1. SUMMARY

- 20 A. Throughout the execution of this contract all contractors shall be responsible for maintaining the project site in a
21 standard of cleanliness as described in this specification.
22 B. All contractors shall also comply with the requirements for cleaning as described in other specifications.
23 C. Work included in this specification shall include but not be limited to:
24 1. Safety Cleaning
25 2. Project Site Cleaning
26 3. Progress Cleaning
27 4. Final Cleaning
28

1.2. RELATED SPECIFICAITONS

- 30 A. Section 01 35 00 Special Procedures
31 B. Section 01 60 00 Product Requirements
32 C. Section 01 74 19 Construction Waste Management and Disposal
33 D. Section 01 76 00 Protecting Installed Construction
34

1.3. QUALITY ASSURANCE

- 36 A. The General Contractor (GC) shall conduct daily inspections, more often if necessary, of the entire project site to
37 ensure the requirements of cleanliness are being met as described within these specifications.
38 B. All contractors shall comply with other regulatory requirements as they apply to waste recycling, reuse, hauling,
39 and disposal requirements of any governmental authority having jurisdiction.
40 C. The Owner reserves the right to have work done by others in the event any contractor fails to perform cleaning
41 as described within these specifications. The cost of any Owner provided cleaning shall be charged to the
42 contractor through a deduct change order.
43

PART 2 - PRODUCTS

2.1. CLEANING MATERIALS AND EQUIPMENT

- 47 A. The Contractor shall provide all required personnel, equipment, and materials necessary to maintain the
48 required level of cleanliness as described in this specification.
49 B. Use only cleaning materials and equipment that are compatible with the surface being cleaned, as
50 recommended by the manufacturer, or as approved by the A/E.
51 C. Use only cleaning materials, equipment, and methods as recommended in the manufacturers care and use guide
52 of the material, finish or equipment being cleaned.
53

PART 3 - EXECUTION

3.1. SAFETY CLEANING

- 57 A. All Contractors shall be responsible for safety cleaning as required by OSHA and other regulatory requirements
58 as applicable.

- 1 B. Safety Cleaning shall include but not be limited to the following:
- 2 1. All work areas, passageways, ramps, and stairs shall be kept free of debris, scrap materials, pallets, and
- 3 other large items that would obstruct exiting routes. Small items such as tools, electrical cords, etc are
- 4 picked up when not in use.
- 5 2. Form and scrap lumber shall have nails/screws removed or bent over. Lumber shall be neatly stacked in
- 6 an area designated by the GC.
- 7 3. Spills of oil, grease, and other such liquids shall be cleaned immediately or sprinkled with sand/oil-dry
- 8 first, then cleaned.
- 9 4. Oily, flammable, or hazardous items shall be stored in appropriate covered containers and storage
- 10 devices unless actively being used.
- 11 5. Oily, or flammable rags, and other such waste shall only be disposed of in authorized covered containers.
- 12 6. Disposal by burning shall not be allowed at any time.
- 13

14 **3.2. PROJECT SITE CLEANING**

- 15 A. This section applies to the general cleanliness of the project site as a whole for the duration of the execution of
- 16 this contract.
- 17 B. Exterior Project Site Areas
- 18 1. The GC and other Contractors as appropriate shall ensure the following levels of cleanliness are applied
- 19 to the exterior project site areas.
- 20 a. The overall appearance of the project site is neat and orderly. Defined areas for material storage,
- 21 material waste, job trailers, and the project area are clean and well maintained.
- 22 b. The construction fence is maintained, erect with no gaps, and properly posted per all regulatory
- 23 requirements.
- 24 c. All erosion control measures are properly maintained, cleaned, and repaired as necessary.
- 25 d. All loose materials (construction or waste) are properly tied or weighted down to resist blowing.
- 26 e. All construction materials are properly covered with fully functional tarps or plastic wrap,
- 27 protected from the weather, coverings are tied, strapped, or weighted down to resist blowing.
- 28 f. Dust control is applied as necessary or as required by any regulatory requirement.
- 29 C. Interior Project Site Areas
- 30 1. All Contractors shall ensure the following levels of cleanliness are applied to the interior project site
- 31 areas.
- 32 a. The overall appearance of the project site is neat and orderly. Defined areas for material storage,
- 33 material waste, and project area are clean and well maintained.
- 34 b. Stored materials are kept in original shipping containers whenever possible. Stored materials not
- 35 in shipping containers are properly stored and protected according to other applicable
- 36 specifications.
- 37 c. All scraps and debris shall be properly disposed of as often as necessary to keep work areas,
- 38 passageways, stairs, and ramps free of debris and clear for emergency exiting.
- 39 d. Boxes, pallets, and other such shipping containers, are broken down, stored in a consolidated area
- 40 or, disposed of as often as is necessary.
- 41 e. Hand tools, supplies, materials, electrical cords not being used are picked up and stored in gang
- 42 boxes, not left as walking hazards in work areas, passageways, etc.
- 43 D. Job Trailer
- 44 1. The interior of the job trailer shall be kept clean and available as a work space at all times. The GC shall
- 45 ensure that the following is provided for within the job trailer:
- 46 a. Meeting space including tables and chairs.
- 47 b. Sufficient space for all contractors to access the official construction documents, provide updates,
- 48 etc.
- 49

50 **3.3. PROGRESS CLEANING**

- 51 A. This sub-section shall apply to all Progress Cleaning prior to the installation of finishes, fixtures, and trim (IE
- 52 rough-in).
- 53 1. For the purposes of this section “clean” shall be defined as a level of cleanliness free of dust and other
- 54 material capable of being removed by use of reasonable effort using a good quality janitor broom and
- 55 shop-vac.
- 56 2. Daily cleanings shall be conducted by all contractors at the end of the work day as follows:
- 57 a. Debris in excavated areas shall be removed prior to backfill and compaction.
- 58 b. Debris in wall cavities, chase spaces, etc shall be removed prior to enclosing the spaces.

- 1 c. Large items shall be properly stored, returned to designated areas, or disposed of as necessary.
- 2 d. Loose materials shall be properly secured.
- 3 e. Flammable or hazardous materials are properly stored or disposed of.
- 4 3. Weekly cleaning shall be conducted by all contractors as designated by the GC. Weekly cleanings shall
- 5 include all the above for a daily cleaning and other necessary cleaning as designated by the GC.
- 6 B. This sub-section shall apply to Progress Cleaning in preparation for the installation of finishes, fixtures, and trim.
- 7 a. Surfaces receiving finishes shall be thoroughly cleaned prior to contractors applying finish
- 8 materials. The GC shall be responsible for inspecting the area and surfaces being cleaned for
- 9 finish prior to the sub-contractor applying the finish. This shall include but not be limited to the
- 10 following:
- 11 i. Wall surfaces shall be wiped clean of dirt and oily residues, vacuumed free of dust, and
- 12 shall be free of surface imperfections prior to painting or installing wall coverings.
- 13 ii. Metal surfaces shall be wiped clean of dirt and oily residues, and be free of surface
- 14 imperfections prior to painting.
- 15 iii. Flooring shall be broom swept of large and loose items then vacuumed clean of dust and
- 16 small particles, and damp mopped clean and dried prior to installing any flooring finish.
- 17 Additional cleaning may be required depending on the preparation requirements
- 18 recommended by the flooring material manufacturer.
- 19 C. This sub-section shall apply to Progress Cleaning after the installation of finishes, fixtures, and trim.
- 20 1. For the purposes of this section "clean" shall be defined as a level of cleanliness free of dust and other
- 21 material capable of damaging or visually disfiguring finished work, finishes, fixtures, and trim.
- 22 2. Progress Cleaning at this point in the contract shall be conducted immediately as follows:
- 23 a. Dust, dirt, etc shall be swept and vacuumed off of finish flooring and trim.
- 24 b. Liquid spills shall be cleaned up according to the spill type. This shall include drips and spills
- 25 caused by paint, stain, sealants, and other such items.
- 26 3. The Contractor(s) at no additional cost to the Owner shall be responsible for replacing any finished work,
- 27 finishes, fixtures, and trim damaged or disfigured because of inadequate or improper cleaning.
- 28

3.4. FINAL CLEANING

- 30 A. As noted in Specification 01 29 76 Progress Payment Procedures, Progress Payment Milestone Schedule, Final
- 31 Cleaning shall not be conducted prior to requesting the 90% contract total progress payment and all of the
- 32 following shall be complete:
- 33 1. All final regulatory inspections including but not limited to Building Inspection Department and Madison
- 34 Fire Department inspections have been successfully completed.
- 35 2. All Quality Management Observation (QMO) reports have been closed out.
- 36 3. All Demonstration and Training has been completed.
- 37 4. All Attic Stock has been consolidated and located to its designated area
- 38 5. All protection for installed construction shall be removed prior to final cleaning by the contractor
- 39 responsible for providing the protections. This shall include the removal of any adhesive residues left
- 40 behind from tapes. Contractors shall only use manufacturer authorized cleaning materials for removing
- 41 adhesives, etc.
- 42 B. For the purposes of this section "clean" shall be defined as a level of cleanliness generally provided by skilled
- 43 cleaners using commercial quality building maintenance equipment and materials.
- 44 C. The GC shall be responsible for ensuring that all requirements under this section are being met.
- 45 D. General Requirements
- 46 1. Employ experienced personnel or professional cleaners for final cleaning as necessary for the areas or
- 47 equipment being cleaned.
- 48 2. Cleaning equipment used shall be commercial grade equipment commonly used by professional cleaners.
- 49 3. Cleaning equipment and materials shall be cleaned, rinsed, or replaced to ensure a uniform level of
- 50 cleanliness is being maintained during the final cleaning. This shall include but not be limited to the
- 51 following:
- 52 a. Vacuum cleaner bags and/or filters are changed and/or cleaned as often as necessary.
- 53 b. Dust & wipe down rags are washed, rinsed, or replaced before starting each room.
- 54 c. Mopping equipment
- 55 i. Mop water for washing shall have cleaning solution added to the amount and temperature
- 56 per manufacturer's recommendations. Mop washing water shall be replaced often to
- 57 maintain the levels of the cleaning solution and temperature required.
- 58 ii. Mop water for rinsing shall remain clean, clear, and be replaced as often as necessary.

- 1 iii. Mop heads shall be rinsed often and replaced as necessary.
- 2 iv. Mop heads and buckets shall be thoroughly rinsed with each change of water.
- 3 v. Only new mop heads shall be used for rinsing.
- 4 E. Refer to all other specifications in this contract for specific requirements regarding final cleaning of finishes,
5 fixtures, equipment, etc.
- 6 F. Exterior Cleaning shall include but not be limited to the following:
7 1. All exterior glazing surfaces have been professionally cleaned and are free of dust and streaking.
8 2. Metal roofs, siding, and other surfaces shall be clean of dirt and free of splashed or excess materials such
9 as sealants, mortar, paint, etc.
10 3. All exterior furnishings shall be clean, waste receptacles shall be empty.
11 4. Paved areas shall be clean, free of dirt, oily stains and other such blemishes
12 5. Exterior lights and diffusers are clean and free of dust.
- 13 G. Interior Cleaning shall include but not be limited to the following:
14 1. Remove all labels, stickers, tags, and other such items which are not required by code as permanent
15 labels.
16 2. All interior glazing surfaces, including mirrors, have been professionally cleaned and are free of dust and
17 streaking.
18 3. All interior surfaces have been cleaned of excess materials such as paint, sealants, etc and have been
19 wiped free of dust.
20 4. Interior metals, fixtures, and trim have been cleaned free of dust and oily residues
21 5. Carpet flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains
22 removed per manufacturers use and care instructions.
23 6. Resilient flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains
24 removed, mopped and buffed per manufacturers use and care instructions.
25 7. Interior non-occupied concrete floors shall be broom cleaned, vacuumed free of dust, excess glues and
26 other stains removed per manufacturers use and care instructions.
27 8. Light fixtures, lamps, diffusers and other such items have been dusted and cleaned as necessary.
28

29 **3.5. CALL BACK WORK**

- 30 A. The GC shall be responsible for ensuring that any contractor returning to the project site for completion or
31 correction work has re-cleaned and restored the area to the levels described in section 3.4 above upon
32 completion of the work. This shall include but not be limited to the following:
33 1. The immediate area(s) where work was completed.
34 2. Adjacent areas where dust or debris may have traveled.
35 3. Other areas occupied during the completion of the call back work.
36 4. Path of entrance/exit, to/from the area(s) of work.
37

38
39
40
41

END OF SECTION

**SECTION 01 74 19
 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

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PART 1 – GENERAL

1.1. SUMMARY

- A. This specification includes administrative and procedural requirements for the recycling, re-use, salvaging, and disposal of non-hazardous construction and demolition waste.
- B. The General Contractor (GC) shall be fully responsible for complying with all applicable ordinances and other such regulatory requirements during the execution of this contract.

1.2. RELATED SPECIFICAITONS

- A. 01 29 76 Progress Payment Procedures
- B. 01 31 23 Project Management Web site
- C. 01 32 19 Submittals Schedule
- D. 01 33 23 Submittals
- E. 01 77 00 Closeout Procedures
- F. Other Divisions and Specifications that may address the proper disposal of construction or demolition waste as it pertains to work being conducted under that particular specification.

1.3. CITY ORDINANCES

- A. There are two (2) Madison General Ordinances (MGO) that the City of Madison has regarding construction and demolition waste.
 - 1. MGO 10.185, Recycling and Reuse of Construction and Demolition Debris, describes the requirements associated with this ordinance including definitions, documentation requirements, and penalties.
 - 2. MGO 28.185, Approval of Demolition (Razing, Wrecking) and Removal, describes the requirements associated with applying for and receiving a demolition permit.
- B. All City of Madison, Board of Public Works, contracts being conducted by City Engineering, Facility Management, for construction, remodeling, or demolition shall comply with the above ordinances regardless of project type or size.

1.4. DEFINITIONS

- A. Clean: Untreated and unpainted material, free of contamination caused by oils, solvents, caulks, and other chemicals.
- B. Construction and Demolition Debris: Materials resulting from the construction, remodeling, repair, and demolition of utilities, structures, buildings, and roads.
- C. Disposal: Off-site removal of construction and demolition debris and the subsequent sale, recycling, reuse, or deposit in authorized landfill or incinerator.
- D. Hazardous: Exhibiting the characteristics of hazardous substance, i.e. ignitability, corrosiveness, toxicity, or reactivity and including but not limited to asbestos containing materials, lead, mercury and PCBs.
- E. Non-hazardous: Exhibiting none of the characteristics of a hazardous substance.

- 1 F. Nontoxic: Not immediately poisonous to humans or poisonous after a long period of exposure.
- 2 G. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured
- 3 into a new product.
- 4 H. Recycle: Any process by which construction or demolition debris is diverted from final disposal as solid waste at
- 5 a permitted landfill and instead is collected, separated, and/or processed into raw materials for new, reused, or
- 6 reconstituted products; or for the recovery of materials for energy production processes.
- 7 I. Recycler: Any recycling facility, transfer station, or other waste handling facility which accepts construction and
- 8 demolition debris for recycling, or for other transferring to a recycling facility.
- 9 J. Recycling: The process of sorting, cleaning, treating, or reconstituting solid waste and other discarded materials
- 10 for the purpose of preparing the material to be recyclable. Recycling does not include burning, incinerating or
- 11 thermally destroying waste.
- 12 K. Return: To give back reusable items or unused products to vendors for credit.
- 13 L. Reuse: Shall mean any of the following:
- 14 1. The on-site use of reprocessed construction and demolitions debris.
- 15 2. The off-site redistribution of a material, for use in the same manner or similar manner at another
- 16 location.
- 17 3. The use of non-toxic, clean wood as an alternative fuel source.
- 18 M. Salvage: To remove a waste material from the project site for resale or reuse by the Owner or others.
- 19 N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- 20 O. Trash: Any product or material unable to be re-used, returned, recycled, or salvaged.
- 21 P. Waste: Extra materials or products that have reached the end of its useful life or its intended use. Waste
- 22 includes salvageable, returnable, recyclable and re-useable construction and demolition materials, and trash.
- 23

24 1.5. PERFORMANCE REQUIREMENTS

- 25 A. The GC shall develop a Waste Management Plan that results in end-of-project rates for salvage/recycling/reuse
- 26 of 95 percent (minimum) by weight of the total waste generated by the Work. Percentages may be adjusted on
- 27 a project by project basis depending on selected LEED goals associated with the project.
- 28 B. The GC shall salvage or recycle 100 percent of all uncontaminated packaging materials including but not limited
- 29 to the following:
- 30 1. Paper
- 31 2. Cardboard
- 32 3. Beverage containers
- 33 4. Boxes
- 34 5. Plastic Sheet and film
- 35 6. Polystyrene packaging
- 36 7. Wood crates and pallets
- 37 8. Plastic pails and buckets
- 38 C. Promote a resourceful use of supplies and materials through proper planning and handling. Generate the least
- 39 amount of waste possible by minimizing errors, poor planning, breakage, mishandling, contamination or other
- 40 similar factors.
- 41 D. Use all reasonable means to divert construction waste from landfills and incinerators through recycling, reuse, or
- 42 salvage as appropriate.
- 43

44 1.6. SUBMITTALS AND DELIVERABLES

- 45 A. The GC shall provide their completed Waste Management Plan to the Project Management Web Site as a
- 46 submittal for review by the Project Architect and City Project Manager.
- 47 1. See item 1.8 below for Waste Management Plan submittal requirements.
- 48 2. The Waste Management Plan shall be completed, submitted, and approved as a pre-requisite for
- 49 Progress Payment number 1.
- 50 3. Copies of all documentation required by this specification shall be submitted to the appropriate Project
- 51 Management Web Site Library. Documentation shall be reviewed by the City Project Manager during all
- 52 Progress Payment reviews for compliance and accuracy.
- 53 B. The Waste Management Coordinator shall provide copies of items 1 through 5 below to the appropriate Project
- 54 Management Web Site Library and shall update the Waste Management Summary Log to reflect the records
- 55 being submitted.
- 56 1. Records of Donations: Indicate receipt and acceptance of itemized salvageable waste donated to
- 57 individuals or organizations. Indicate if the organization is tax exempt.

- 1 2. Records of Sales: Indicate receipt and acceptance of itemized salvageable waste sold to individuals or
2 organizations. Indicate if the organization is tax exempt.
- 3 3. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by
4 recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts and
5 invoices.
- 6 4. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and
7 incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.
- 8 5. Statement of Refrigerant Recovery: The Refrigerant Recovery Technician responsible for recovering
9 refrigerant shall provide the GC with a statement indicating all of the following:
10 a. All recovery was performed according to EPA Regulations.
11 b. All refrigerant present was recovered; indicate the total quantity recovered by unit.
12 c. Date of Recovery.
13 d. Name, address, company name, and phone number of technician performing the recovery.
14 e. Technician shall sign and date the statement.
- 15 C. LEED Submittal: The GC shall provide the following information using the appropriate LEED letter template upon
16 project completion: indicating that the requirements of the credit have been met. *NOTE: This requirement shall*
17 *only apply to projects having a LEED certification goal.*
18 1. Total waste material generated.
19 2. Total waste material diverted by diversion method; recycling, salvage, re-use, etc.
20 3. Statement that the credit requirements have been met.
21 4. GC shall sign the letter.

22
23 **1.7. QUALITY ASSURANCE**

- 24 A. Waste Management Coordinator: The GC shall be responsible for designating a Waste Management
25 Coordinator. Coordinator may be the GC Supervisor, GC Project Manager or other member of the GC staff
26 having knowledge of proper waste management procedures and all applicable regulations.
- 27 B. Regulatory Requirements: comply with all hauling and disposal regulations of authorities having jurisdiction.
- 28 C. The Waste Management Coordinator shall comply with Specification 01 31 19 Project Meetings, Section 3.7.B.1
29 and conduct a Waste Management Conference at the job site. This conference shall be repeated as necessary as
30 additional trades are added to the Work. The conference shall include but not be limited to the following:
31 1. Identify the Waste Management Coordinator; provide trade contractors with name, phone, and email
32 information.
33 2. Review and discuss the Waste Management Plan and the roles of the Coordinator.
34 3. Review the requirements for documenting and reporting procedures of each type of waste and its
35 disposition.
36 4. Review procedures for material separation; indicate availability and locations of containers and bins.
37 5. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
38 6. Review waste management procedures specific to each trade.
- 39 D. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

40
41 **1.8. WASTE MANAGEMENT PLAN**

- 42 A. Develop a plan consisting of waste identification, a waste reduction work plan, and cost/revenue analysis.
43 Indicate quantities by weight or volume. Use the same units of measure throughout the waste management
44 plan.
45 1. Waste Identification: Indicate anticipated types and quantities of site clearing, demolition waste, and
46 construction waste that will be generated during the execution of this contract. Include assumptions for
47 the estimates.
- 48 2. Waste Reduction Work Plan: The work plan shall consist of but not be limited to all of the following:
49 a. Identify methods for reducing construction waste. Re-using, framing and forming materials, re-
50 planning material cuts to minimize waste, etc.
51 b. Identify what types of materials will be recycled. Provide lists of local companies that receive
52 and/or process the materials. Include names, addresses, and phone numbers.
53 c. Identify what types of materials will be disposed of and whether it will be disposed of in a landfill
54 facility or by incineration facility. Provide lists of local companies that receive and/or process the
55 materials. Include names, addresses, and phone numbers.
56 d. Identify methods to be used on site for separating waste including all of the following:
57 i. Sizes of containers to be used.
58 ii. Labels to be used on the containers to identify the type of waste allowed in the container.

- 1 iii. Designated locations on the project site for waste material containers.
- 2 B. If project requires demolition incorporate the ordinance required (MGO 28.185) Recycling and Reuse Plan into
- 3 the Waste Management Plan.
- 4 C. Provide all of the following for the Waste Management Coordinator:
- 5 1. Name, employer, employer address, phone number, and email address of the designated coordinator.
- 6 a. The GC shall also provide this information with the required Project Directory Submittal at the
- 7 beginning of the project.
- 8 D. If at the option of the GC, they choose to contract with a Waste Management Disposal Company that allows
- 9 comingled and unsorted waste materials, the GC shall include with their Waste Management Plan the following:
- 10 1. Name, address, phone number, state permitting information, and other pertinent information about the
- 11 disposal company.
- 12 2. Documentation from the disposal company indicating company policies and procedures regarding
- 13 comingled and unsorted waste materials to include:
- 14 a. GC responsibilities on the project site.
- 15 b. Disposal company procedures for receiving, sorting, recycling, and disposing of comingled and
- 16 unsorted waste material.
- 17

18 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

19

20 **PART 3 - EXECUTION**

21

22 **3.1. PLAN IMPLEMENTATION**

- 23 A. Implement the approved waste management plan. Provide adequate containers, storage space, signage,
- 24 transportation and other items required to implement the plan during the execution of this contract.
- 25 B. The GC and Waste Management Coordinator shall be responsible for monitoring and reporting the status of the
- 26 Waste Management Plan and shall monitor the waste management practices on site as frequently as needed.
- 27 C. Train all workers, sub-contractors, and suppliers on proper waste management procedures as appropriate for
- 28 the work being conducted on the project site.
- 29 1. Distribute the waste management plan to everyone concerned within seven (7) days of submittal
- 30 approval.
- 31 2. Distribute the waste management plan to new workers, sub-contractors, and suppliers when they first
- 32 appear on the project site.
- 33 3. Conduct additional training as needed during the execution of the contract to keep a positive focus on
- 34 the waste management plan.
- 35 D. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways,
- 36 and other adjacent and used facilities.
- 37 1. Designate and label specific areas on the project site necessary for separating materials to be salvaged,
- 38 recycled, reused, donated, and sold.
- 39 2. Comply with any specification or regulatory requirements pertaining to dust, dirt, environmental
- 40 protection, and noise control.
- 41

42 **3.2. HAZARDOUS AND TOXIC WASTE**

- 43 A. The Owner shall be responsible under separate contract for the removal of any asbestos related materials. All
- 44 other materials shall be removed by the GC.
- 45 B. All hazardous and toxic waste shall be separated, stored, and disposed of according to all applicable regulations.
- 46 C. All hazardous and toxic materials on site shall have a Material Safety and Data Sheet (MSDS) available that
- 47 indicates storage requirements, emergency information, and disposal requirements as necessary.
- 48

49 **3.3. GENERAL GUIDELINES FOR ALL WASTES**

- 50 A. Recycle all paper and beverage containers used by workers, sub-contractors, suppliers and visitors to the project
- 51 site.
- 52 B. All revenues, savings, rebates, tax credits, and other such incentives received from recycling, reusing, or
- 53 salvaging waste materials shall accrue to the GC unless specified otherwise in the contract documents.
- 54 C. Separate recyclable, reusable, and salvageable waste from other waste materials, trash, and debris except where
- 55 Waste Management Disposal Company allows comingled waste materials, see section 1.8.D above.
- 56 1. Separate by type in appropriate containers or designated areas according to the approved waste
- 57 management plan away from the construction area. Do not store within the drip lines of existing trees.

- 1 2. Inspect containers and bins frequently for contamination and inappropriately sorted materials. Remove
- 2 contaminated materials and resort as necessary.
- 3 3. Stockpile bulk materials such as sand, topsoil, stone, etc., on site away from the construction area and
- 4 without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water, and
- 5 cover to prevent windblown dust. Do not store within the drip lines of existing trees.
- 6 4. Whenever possible store items off the ground and/or protect them from the weather.
- 7

8 **3.4. GUIDELINES FOR RECYCLABLE, RE-USABLE, AND SALVAGEABLE WASTE**

- 9 A. The following guidelines is not a complete or all inclusive list and shall be adjusted as needed by the methods
- 10 and procedures identified in the Waste Management Plan.
- 11 B. Asphalt Paving: Break-up into transportable pieces or grind, transport to an authorized recycling facility.
- 12 C. Carpet and Pad: Separate carpet and pad scraps, containerize and transport to an authorized recycling facility.
- 13 D. Ceiling System Components: Suspended ceiling system components shall be sorted by material type as follows:
- 14 1. Broken, cut, or damaged tiles shall be containerized, transport to an authorized recycling facility.
- 15 2. Damaged, or cut tracks, trim and other metal grid system components shall be sorted with other metals
- 16 of similar types, palletize, transport to an authorized recycling facility.
- 17 E. Clean Fill: When allowed by Division 31 Specifications; concrete, masonry, stone, asphalt pavement, sand and
- 18 other such materials may be used as clean fill on this project site. The GC shall verify with the Project Architect,
- 19 Structural Engineer, or Civil Engineer as necessary prior to using any materials as clean fill. Materials shall be
- 20 processed, placed, and compacted as specified. If not being re-used on site, transport to an authorized recycling
- 21 facility.
- 22 F. Clean Wood Materials: Including but not limited framing cutoffs, wood sheathing or paneling materials,
- 23 structural or engineered wood products, and pallets or crates. Clean Wood shall be free of paints, stains, oils,
- 24 preservatives and other such contaminants.
- 25 1. Useable pieces shall be sorted by type and dimension, bundled and transported off site by the GC or
- 26 returned to the supplier.
- 27 2. Non-useable pieces shall be palletized or containerized, transport to an authorized recycling facility.
- 28 3. Clean, uncontaminated sawdust and wood shavings shall be bagged, transport to an authorized recycling
- 29 facility.
- 30 G. Concrete: Break-up into transportable pieces, remove all reinforcing and other metals, transport to an
- 31 authorized recycling facility.
- 32 H. Glass Products: Shall be sorted by types, do not include light fixture lamps and bulbs. Products broken in
- 33 shipment shall be returned to the supplier. Broken or cracked items still in frames shall be taped to prevent
- 34 further breakage and injury to workers. Transport to an authorized recycling facility.
- 35 I. Gypsum Board: Stack large clean pieces on wooden pallets or container, store in a dry location, transport to an
- 36 authorized recycling facility.
- 37 J. Light Fixture Lamps and Bulbs: Fluorescent tubes shall be containerized, transport to an authorized recycling
- 38 facility.
- 39 K. Masonry and CMU: Remove all metal reinforcing, anchors, and ties, clean undamaged pieces and neatly stack on
- 40 pallets, transport damaged pieces to an authorized recycling facility.
- 41 L. Metals: Sort metals by type as follows, this does not include piping:
- 42 1. Architectural metals including but not limited to siding, soffit, and roofing panels shall be sorted by
- 43 material, palletize or bundle as needed and transport to an authorized recycling facility.
- 44 2. Structural steel, sort by size and type; palletize and transport to an authorized recycling facility.
- 45 3. Miscellaneous metals such as aluminum, brass, bronze, etc shall be sorted by type, containerized or
- 46 palletized as necessary, transport to an authorized recycling facility.
- 47 M. Packaging and shipping materials
- 48 1. Cardboard boxes and containers: Breakdown all cardboard boxes and containers into flat sheets. Bundle
- 49 and store in a dry location until transported for recycling.
- 50 2. Pallets:
- 51 a. Whenever possible require deliveries using pallets to remove them from the project site.
- 52 b. Neatly stack pallets in preparation for reusing them or providing them to other companies for
- 53 salvage or re-use.
- 54 c. Break down pallets into component wood pieces that comply with the requirements for recycling
- 55 clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
- 56 3. Crates: Break down crates into component wood pieces that comply with the requirements for recycling
- 57 clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
- 58 4. Polystyrene Packaging: Separate and bag materials.

- 1 N. Piping and conduit: Reduce all piping and conduit to straight lengths, sort and store by size, material and type.
2 Remove supports, hangers, valves, boxes, sprinkler heads, and other such components, sort and store by size,
3 material and type. Transport to authorized recycling facilities according to material types.
4 O. Roofing: Roofing materials shall be sorted and containerized by type, transport to authorized recycling facilities
5 according to material types.
6 P. Site-Clearing Waste: Sort all site waste by type.
7 1. Only stockpile soils types and quantities required for re-use on the project site. All remaining quantities
8 shall be transported off site to an authorized facility that receives such materials.
9 2. Brush, branches, and trees with no marketable re-use shall be transported to facilities for chipping into
10 mulch.
11 3. Trees with a marketable re-use shall be salvaged and transported to facilities that specialize in processing
12 trees for future use as wood products.
13

14 **3.5. GUIDELINES FOR DISPOSAL OF WASTES**

- 15 A. The following guidelines shall be adjusted as needed by the methods and procedures identified in the Waste
16 Management Plan.
17 B. Any waste that is contaminated, organic, or cannot be recycled, re-used, or salvaged shall be legally disposed of
18 in an authorized landfill or incinerator. Disposal methods shall follow all applicable regulatory requirements.
19 C. No waste material of any kind, except those types designated as clean fill in section 3.4 above, shall be allowed
20 to be buried on the project site at any time.
21 D. No burning of any kind of waste material shall be permitted on this project site at any time.
22 E. Paint and Stain: Paints, stains, and their containers shall be disposed of as follows:
23 1. Whenever possible containers should be thoroughly cleaned immediately after emptying and sorted with
24 as appropriate (metal or plastic) for recycling
25 2. Empty containers, regardless of type or base material, may be disposed of with lids off with general
26 garbage.
27 3. Latex paint may be placed with general garbage if properly solidified as follows:
28 a. Small amounts (an inch or less in can): Remove lids and allow paint to dry out in the can and
29 harden. Protect cans from rain and freezing.
30 b. Large amounts (more than one inch): Mix paint with equal amounts of cat litter, stir and allow to
31 completely dry. Alternate method: mix with commercial paint hardener.
32 4. Oil-based or combustible paints and stains, regardless of liquid or solid, shall be transported to an
33 approved facility that takes such items such as Dane County Clean Sweep Sites.
34 F. Treated Wood Materials: Treated wood materials including but not limited to wood that has been painted,
35 stained, or chemically treated shall not be recycled or incinerated.
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END OF SECTION

SECTION 01 76 00
PROTECTING INSTALLED CONSTRUCTION

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PART 1 – GENERAL

1.1. SUMMARY

- 25 A. The purpose of this specification is to provide clear responsibilities, guide lines, and requirements related to
26 providing protection to already installed construction.
27 B. Already installed construction shall include but not be limited to the following:
28 1. Any existing site feature such as pavement, curbs, drainage features, utilities, landscaping features (trees,
29 shrubbery, plantings, flagpoles, etc) and other such exterior items not associated with the building
30 whether on or adjacent to the project site.
31 2. Any existing structure on or adjacent to the project site.
32 3. Any existing interior work that may be adjacent to the new work including all paths of ingress/egress to
33 areas associated with accessing the Work.
34 4. Any existing feature of any kind within the public right-of-way that may be on the project site property,
35 adjacent to the project site or across the street from the project site.
36 C. All contractors shall be familiar with the specifications of their Division of Work for specific requirements on
37 protection of the Work.
38 D. The requirements noted within this specification do not relieve any contractor of the responsibility for
39 compliance with any code, statute, ordinance, or other such regulatory requirement having jurisdictional
40 authority over these contract documents.

1.2. QUALITY ASSURANCE

- 43 A. It shall be the responsibility of every contractor and worker assigned to the project to be diligent in protecting all
44 existing work, and newly installed construction.
45 B. It shall be the General Contractors' (GC) responsibility under the contract to provide all reasonable protection
46 methods, materials, or precautionary measures required to protect new or existing construction as described in
47 within this specification to the project as a whole.
48 1. The GC shall be responsible to ensure any damaged new or existing construction is repaired or replaced
49 at no additional cost to the Contract.
50 2. The GC at their discretion may direct other contractors to provide and maintain protection of completed
51 work associated with their Division of Work. I.E.: The carpet installer may be required by the GC to
52 provide carpet protection along traveled paths, ingress/egress, etc after installation.
53 C. It shall be the responsibility of the GC to ensure that all materials being used to protect installed construction are
54 compatible with, and/or adjacent to, the materials being protected. This shall include but not be limited to the
55 material used as covering, tapes used to fasten protective materials, etc.

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1.3. RELATED SPECIFICATIONS

- A. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public Works Construction”.
 - 1. Use the following link to access the Standard Specifications web page:
<http://www.cityofmadison.com/business/pw/specs.cfm>
 - a. Click on the “Part” chapter identified in the specification text. For example if the specification says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II PDF will open.
 - b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you to the referenced text.
 - c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.
- B. Section 01 60 00 Product Requirements
- C. Section 01 74 13 Progress Cleaning

PART 2 - PRODUCTS

2.1. FENCING MATERIALS AND BARRICADES

- A. The existing property is fenced and gated that can be used to secure the site where shown on the Civil Drawings, if the contractor requires additional fencing for construction purposes then the responsible contractor shall provide a six foot galvanized chain link fence including full height mesh screen. For temporary barricade situations, the responsible contractor may provide one of the following that sufficiently provide a sturdy physical barrier and/or visual barrier as necessary for the intended application.
 - 1. Standard orange construction barrels each with a standard rubber base ring and reflective tape
 - a. Provide flashing amber lights as needed to increase night time visibility
 - 2. Steel “T” style fence posts
 - 3. 4’0” high standard orange construction fence
 - 4. Traffic barricades
 - 5. Jersey barriers
 - 6. Other types of fencing or barricades typically used in the construction industry
- B. The contractor responsible for providing the fencing materials and barricades shall also be responsible for maintaining them. This shall include but not limited to fixing damaged fencing, standing up barrels that have been knocked over, realigning barrels, and ensuring flashing lights are fully operational at all times.
- C. The following fencing and barricade designations, and their use descriptions shall be used throughout this specification to provide uniformity in describing protection requirements.
 - 1. Type A, Jersey Barriers, to be used as permanent blocking devices to deny access to alternate project site entrances or exits.
 - 2. Type B, Traffic Barricades, to be used as temporary blocking devices to deny access to alternate project site entrances or exits.
 - 3. Type C, Construction Barrels without construction fencing shall be used for lane closures, temporary blocking devices to deny access and the protection of single locations (I.E. identify the location of an access structure) that do not require fencing.
 - 4. Type D, Construction Barrels with construction fencing where it becomes necessary to surround an object with a complete visual barricade and it is impractical or unacceptable to install fence posts. The surround shall be constructed in such a manner as to provide a buffer zone around and access to the item being protected.
 - 5. Type E, Steel “T” Fence Posts shall be used at the project lines, as indicated on the Civil Drawings if required, with six foot galvanized chain link fencing to surround an object with a complete visual barricade and it is practical to install fence posts. The surround shall be constructed in such a manner as to provide a buffer zone around and access to the item being protected. All posts shall be driven installed. Surface mounted posts to only be used for temporary barricades.
 - 6. Type X, Other fencing or barricade types that may be designated and detailed within the construction documents shall use additional alpha numeric designations.

2.2. EROSION CONTROL PROTECTION

- A. Refer to City of Madison Standard Specification 210.2 for authorized materials associated with erosion control materials.

1 **2.3. INTERIOR FINISH PROTECTION MATERIALS**

- 2 A. Except where noted in other areas of the construction documents or this specification the responsible
3 contractor:
4 1. Shall not provide the cheapest or least effective method as an effort to meet any protection requirement.
5 2. Shall provide materials of sufficient quality, and durability to provide adequate protection based on the
6 seasonal conditions and the anticipated duration at the time the protection will be needed.
7 3. Shall provide sufficient quantity of protection material to protect the construction as needed.
8 B. Prior to installing protective measures the responsible contractor shall propose to the GC, Project Architect
9 (PA)/Project Engineer (PE) and City Project Manager (CPM) the proposed plan for protection, materials to be
10 used and samples as necessary.
11 1. The PA/PE and CPM reserve the right to disapprove any proposed method and/or material and/or make
12 alternate proposals.
13

14 **PART 3 - EXECUTION**

15
16 **3.1. GENERAL EXECUTION REQUIREMENTS**

- 17 A. The GC shall be responsible for ensuring all of the following procedures and requirements are implemented as
18 needed for the duration of the Work performed under this contract.
19 B. The GC shall also be responsible for the following:
20 1. Reporting any incident of damage to existing property, right-of-way, or utility to the CPM immediately
21 upon rendering the incident safe, and notifying emergency response teams, and emergency utility crews
22 as needed.
23 2. Conduct a site walk through prior to leaving at the end of each day to assess:
24 a. Protection measures are properly in place, provide correction actions as necessary.
25 b. Note damage to existing completed work and schedule repair/replacement as needed.
26 3. Ensure all contractors and workers are being diligent in protecting existing work, and newly installed
27 construction.
28

29 **3.2. PROTECT ADJACENT PROPERTIES**

- 30 A. Whenever possible through the design process the City of Madison shall have previously provided notice to
31 adjacent property owners that work will be occurring on or near their property. The City of Madison shall also
32 have obtained any permanent or temporary easements that may be necessary to complete any Work on
33 adjacent properties.
34 B. It shall be the responsibility of the GC to do the following for all Work under this contract being performed on or
35 adjacent to the property line:
36 1. Contact the adjacent property owner and provide them with information on the work to be done,
37 equipment to be used, and estimated duration of the work. Information to be updated and
38 communicated to property owner(s) as construction progresses and site conditions change.
39 a. If any adjacent property is a rented or leased space the GC shall also make contact and provide
40 the same information to the tenants.
41 b. Determine from the owner and/or tenants if there are any concerns for children, pets, special
42 plantings, or other concerns.
43 2. Discuss the following with all contractors performing work on or near the property line.
44 a. Work to be completed and timeline.
45 b. Concerns of adjacent property owners/tenants from item 1 above.
46 c. Which protective measures will be necessary to protect adjacent properties and address the
47 concerns of adjacent property owners/tenants.
48 3. Ensure all protective measures are placed and maintained during the execution of Work on or adjacent to
49 the property line. Interact with the adjacent property owners/tenants as needed.
50 C. Any contractor doing work on or adjacent to the property line shall install and maintain any protective measure
51 identified in the contract documents, this specification, or as directed by the GC.
52 D. The GC shall be responsible for restoring any damage to structure and property located on or adjacent to the
53 property line.
54 1. Restoration shall include but not be limited to repair or replacement using like materials and finishes to
55 its original condition or better.
56 2. Restoration of landscaping materials shall include watering of any seed, sod, or other planting of any kind
57 for a reasonable period of time to encourage germination and root development.
58 E. The GC shall keep the CPM informed directly to any issues pertaining to adjacent property owners and tenants.

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3.3. PROTECT LANDSCAPING FEATURES

- A. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. Whenever possible do not install new landscape features until exterior building construction has been completed, equipment such as scaffolding and lifts are no longer needed and have been removed, and heavy equipment operation is no longer required.
 - 2. Whenever possible remove and temporarily store all existing landscape features such as benches, waste receptacles, signage, and other such features that will be within the area of Work that can be removed.
 - 3. Landscape features that cannot be removed such as flag poles, light poles, light bollards, etc. shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
 - 4. Planting beds shall be protected using Type E fencing around the exposed perimeter of the planting bed as needed.
 - 5. The City of Madison Standard Specification 107.13 shall apply to all tree protection in and around the project site at all times.

3.4. PROTECT UTILITIES

- A. The contractor shall be responsible for notifying all utilities to determine emergency response procedures and protection requirements prior to installing any construction protection.
 - 1. This includes requesting utility marking through Diggers Hotline.
 - a. Call 811 or 1-800-242-8511 to request a public utility locate
 - b. For emergency locate call (262) 432-7910 or (877) 500-9592
 - 2. Contact the Owner and CPM for any available private utility information on the property that may be available prior to calling a private utility locating company.
- B. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. Hydrants, lamp posts, electrical transformers, and other utility pedestals shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil. Fence posts shall be located so as to not be directly over the utility main.
 - 2. Storm sewer structures in pavement shall have proper inlet protection according to City of Madison Standard Specification 210.1(g) and Type C Construction Barrels when necessary.
 - 3. Storm sewer structures in turf and other landscaped areas shall have proper inlet protection according to City of Madison Standard Specification 210.1(g) and Type E fencing for areas on soil.
 - 4. Stormwater management features such as greenways, retention/detention ponds, bio-filtration ponds and other such features shall be properly protected according to the appropriate erosion control measure specified on the Erosion Control Plan. See multiple sections of City of Madison Standard Specification 210.1
 - a. For the protection of hard to see items such as structures, castings, inlets, etc. in grassy areas provide Type E fencing for areas on soil.
 - c. For the protection of storm water management features having special soils and plants such as bio-filtration ponds provide Type E fencing for areas on soil.
 - 5. Other structures and covers including but not limited to cleanouts, wiring hand holes, valve boxes, access structures, grease trap structures, etc shall be protected as follows:
 - a. Provide Type E fencing for areas on soil.
 - b. When paving operations are complete provide a construction barrel or cone near structures as necessary depending on required heavy construction traffic.

3.5. PROTECT PUBLIC RIGHT OF WAY

- A. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. All public right-of-way (area from behind the sidewalk to the centerline of the street) shall remain open and accessible except during periods of active work. At such times the public right of way shall be properly closed and signed as referenced in City of Madison Standard Specification 107.9.
 - 2. Bus stops and bus stop structures shall remain accessible at all times.
 - 3. Traffic signage and traffic signals, traffic control boxes shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
 - a. Protection at traffic signage/signals shall not obstruct the viewing of the sign/signal for its intended purpose at any time.

- 1 B. When additional protection for traffic control is required, the use of barricades, guardrails, lane closures and
2 other such procedures will be detailed within the construction documents.
3 C. When additional protection for overhead sidewalk cover is required the contract documents shall indicate the
4 specific location and structural requirements of the protective structure.
5

6 **3.6. PROTECT STORED MATERIALS**

- 7 A. All contractors shall refer to Specification 01 60 00 Product Requirements for all storage and protection
8 requirements of building materials and products delivered to the site.
9

10 **3.7. PROTECT WORK - EXTERIOR**

- 11 A. Provide all temporary services that may be required to protect the installed material from heat, cold, humidity,
12 etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
13 B. Open trenches, pits, and other such excavations shall be properly covered, lined, or shored as needed during
14 periods of inclement weather to prevent the caving of soils onto existing work in progress. Refer to the
15 appropriate specifications and/or regulatory requirements governing this type of work as necessary.
16 C. Provide adequate protection at all openings with heavy duty tarps, plastic sheathing, or wood framing and
17 sheathing as needed to protect interior work in progress from inclement weather as needed.
18 D. Protect exterior finishes of all kinds with heavy duty tarps or plastic sheathing as needed while landscaping is
19 being installed through full germination of seeded areas or installation of filter fabric and mulches to keep dust,
20 dirt, and mud off of finished exterior surfaces.
21 E. Designate specific curb mounting points and provide wood blocking where small vehicles, skid loaders and other
22 such equipment may need access to areas being landscaped.
23 F. Provide plywood turning pads for skid loaders to turn on to prevent tire marking on new pavement.
24 G. Do not permit the parking of vehicles with any kind of fluid leaks to park on new pavement.
25 H. The contractor shall be responsible for cleaning, repairing, or replacing any completed work or work in progress
26 under this specification as deemed necessary by the CPM without additional cost to the contract.
27

28 **3.8. PROTECT WORK - INTERIOR**

- 29 A. The GC shall do all of the following:
30 1. Provide all temporary services that may be required to protect the installed material from heat, cold,
31 humidity, etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
32 2. Provide adequate visual and/or physical protection as needed to protect newly completed interior work
33 such as paint, flooring material, sealants, grouts, etc that may be drying and/or curing.
34 3. Provide adequate space and materials for cleaning boots, tool boxes, supplies, and other items coming
35 into the project site once finish work has begun.
36 4. Clean dirtied areas and repair/replace damaged areas immediately.
37 B. The contractors responsible for interior work shall be responsible for protecting their work and finishes from dirt,
38 mud, snow, spills, splatters, and physical damage after installation as follows:
39 1. Protect vinyl composite, rubber composite, painted/stained concrete, and tiled flooring as follows:
40 a. Define foot traffic areas and protect with Ramboard Temporary Floor Protection products as a
41 minimum basis of design or other protection product(s) compatible with installed flooring product
42 if Ramboard is not compatible. Products to be used shall be new.
43 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
44 not allow any debris or other material between the installed flooring and the protection
45 material.
46 ii. Repair tears immediately, replace worn areas with like material as necessary.
47 2. Protect carpeted areas as follows:
48 a. Define foot traffic areas and protect with a minimum of 6mil, clear, polyethylene sheeting 3 feet
49 wide. Products to be used shall be new.
50 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
51 not allow any debris or other material between the installed flooring and the protection
52 material.
53 ii. Repair tears immediately, replace worn areas with like materials as necessary.
54 3. Protect all finished walls in high traffic areas with Ramboard Temporary Wall protection products or
55 approved equal.
56 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
57 not allow any debris or other material between the installed flooring and the protection
58 material.

- 1 ii. Repair tears immediately, replace worn areas with like materials as necessary.
2 3. Protect counter tops, cabinets, and other finished surfaces with large sheets of thick cardboard or
3 Ramboard products. Do not allow toolboxes, finish materials, parts and other such items to be placed on
4 finished materials.
5 C. All protection shall stay in place until the CPM, PA/PE, and GC mutually deem the project is ready for Final
6 Cleaning. The contractors responsible for protecting the work shall be responsible for removing the protection
7 and removing any adhesive residue at that time. Contractors shall only use manufacturer authorized cleaning
8 materials for removing adhesives, etc.
9 D. Contractors doing work in un-protected areas of finished work shall be required to provide drop cloths and other
10 protection as noted within this specification for the duration of their work.
11 1. Finished areas shall be sufficiently covered to accommodate all equipment, and materials being used to
12 complete the work being done.
13 2. Finished areas shall be sufficiently covered to prevent splatters, over spray, etc when doing touch-up
14 work.
15 3. Contractors who do not provide sufficient protection under this sub-section shall be responsible for any
16 costs associated with cleaning, repairing or replacing already finished construction at no additional cost
17 to the contract.

18
19
20 **END OF SECTION**

21
22

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

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17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The purpose of this specification is to clearly define and quantify the requirements associated with closing a City
22 of Madison Public Works Contract for facility related work.
23 B. All contracts have two distinct but related paths. Each path needs to be properly closed independently in order
24 to close the contract as a whole.
25 1. Construction closeout is related to closing out all of the Work associated with the construction
26 documents.
27 a. It shall be the responsibility of all contractors to be fully aware of the required Work and closeout
28 requirements involved in their individual trades.
29 2. Contract closeout is related to closing out all of the administrative aspects of the contract in general.
30 a. It shall be the responsibility of all contractors to be fully aware of the administrative requirements
31 required by the contract and to provide the supporting documentation required.
32 3. Construction Closeout must be completed before Contract Closeout can begin.
33 C. This specification will provide general knowledge associated with the following areas:
34 1. Construction Closeout Requirements
35 2. Construction Closeout Procedure
36 3. Contract Closeout Requirements
37 4. Contract Closeout Procedure
38 5. Final Payment and Certificate of Completion
39

1.2. RELATED SPECIFICATIONS

- 41 A. Contractors shall review all references to other specifications including specifications relating to the execution of
42 the Work associated with their Division or Trade.
43 B. Section 01 29 76 Progress Payment Procedures
44 C. Section 01 31 23 Project Management Web Site
45 D. Section 01 32 26 Construction Progress Reporting
46 E. Section 01 45 16 Field Quality Control Procedures
47 F. Section 01 74 13 Progress Cleaning
48 G. Section 01 45 16 Construction Waste Management and Disposal
49 H. Section 01 76 00 Protecting Installed Construction
50 I. Section 01 78 13 Completion and Correction List
51 J. Section 01 78 23 Operation and Maintenance Data
52 K. Section 01 78 36 Warranties
53 L. Section 01 78 39 As-Built Drawings
54 M. Section 01 78 43 Spare Parts and Extra Materials
55 N. Section 01 79 00 Demonstration and Training
56 O. Section 01 91 00 Commissioning
57 P. Other requirements as noted in the contract documents signed by the General Contractor
58

1 **1.3. DEFINITIONS**

- 2 A. **Substantial Compliance:** A letter provided to the City of Madison Building Inspection and signed by the Project
3 Architect indicating that all Work has been completed to a level that would allow Owner Occupancy and that all
4 construction is in compliance with the construction documents. A copy of this letter is also provided to the
5 State of Wisconsin Department of Health and Safety as necessary to clear plan review requirements. This letter
6 does not represent construction closeout.
- 7 B. **Certificate of Occupancy:** The Regulatory letter from the City of Madison Building Inspection Department
8 indicating that all regulatory requirements and inspections have been completed and the building may now be
9 occupied for its intended use. This letter does not represent construction closeout.
- 10 C. **Certificate of Substantial Completion:** A letter provided by the Department of Public Works, signed by the City
11 Engineer indicating that Construction activities are substantially complete. This letter does represent
12 construction closeout and the date of this letter begins the date of the Warranty Period.
- 13 D. **Construction Closeout:** The point in the contract where all contractual requirements associated the execution of
14 the Work as described in the plans, specifications, and other documents have been successfully met and the
15 items described in 1.3.A, .B, and .C above have been completed.
- 16 E. **Final Progress Payment:** The progress payment associated with achieving Construction closeout as described in
17 1.3.D above. At this point the contractor may request all monies associated with the contract be paid with the
18 exception of held retainage.
- 19 F. **Contract Closeout:** The point in the contract where all contractual requirements associated with the City of
20 Madison, Board of Public Works contract has been successfully met.
- 21 G. **Final Payment:** The final contract payment submittal that may be approved by the City of Madison after all
22 contractual requirements of the Public Works Contract have been met and any remaining monies (retainage)
23 due to the contractor may be released for the Final Payment.
- 24

25 **1.4. QUALITY ASSURANCE – CONSTRUCTION CLOSEOUT**

- 26 A. All contractors shall be responsible for properly executing the construction closeout requirements associated
27 with their Work as described in the specifications governing their Work.
- 28 B. The GC shall be responsible for all of the following:
- 29 1. Ensuring that all contractors have met the construction closeout requirements associated with their
30 Work.
- 31 2. Coordinate the collection of all construction closeout deliverables from all contractors, provide the
32 deliverables to the Project Architect and City Project Manager for review as necessary, and ensure all
33 contractors correct deficiencies of deliverables and resubmit as needed for final acceptance.
- 34 3. Ensure all closeout requirements identified in the Construction Closeout Checklist below have been
35 completed as intended by the construction documents.
- 36

37 **1.5. QUALITY ASSURANCE – CONTRACT CLOSEOUT**

- 38 A. The City of Madison, Department of Civil Rights (DCR) monitors contract compliance for construction and
39 procurement contracts to ensure that local, state and federal regulations are followed by contractors working on
40 City of Madison Public Works (PW) projects. DCR will monitor all PW projects from contract award through the
41 final payment at the close of the project. Contractors will be required to submit reporting paperwork
42 throughout the PW project process.
- 43 1. Contractors are encouraged to visit the web site identified below for additional information, checklists,
44 forms, and other information provided by DCR as it relates to Contract Compliance.
45 <http://www.cityofmadison.com/Business/PW/contractCompliance.cfm>
- 46 2. Questions regarding the process should be directed to parties and offices as identified on the various
47 forms, documents, and instructions or contact:
48 City of Madison, Department of Civil Rights
49 210 Martin Luther King Jr. Blvd., Room 523
50 Madison, WI 53703
51 (608) 266-4910
- 52 B. All Sub-Contractors have submitted the applicable required documents described in item 1.5.D below to the
53 General Contractor (GC) for Contract Closeout.
- 54 C. The GC has submitted the required applicable documents described in item 1.5.D below for all contractors to the
55 appropriate City of Madison Agency per instructions associated with each submittal.
- 56 D. The documents required for submittal to the City of Madison for Contract Closeout may include any/all of the
57 items listed below depending on contract type. It is the sole responsibility of all contractors to know and submit
58 the required and complete documentation in a timely fashion.

- 1 1. Weekly Payroll Reports
- 2 2. Employee Utilization Reports
- 3 5. Documentation required for Small Business Enterprise (SBE) goals
- 4 6. Other documents as maybe required or requested through the Finalization Review Process

6 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

8 **PART 3 - EXECUTION**

10 **3.1. CONSTRUCTION CLOSEOUT CHECKLIST**

- 11 A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Construction Closeout Requirements to the GC.
- 12 1. The checklist shall include all items identified within the construction documents that require any of the
- 13 following (and examples) prior to moving into Contract Closeout Procedures:
- 14 a. Documents indicating a specified level of performance has been achieved, such as:
- 15 i. Test reports of all types
- 16 ii. Startup reports
- 17 b. Required documentation, such as:
- 18 i. As-builts and record drawings
- 19 ii. Operation and maintenance data
- 20 c. Physical items to be turned over to the owner, such as:
- 21 i. Attic stock
- 22 ii. Keys
- 23 d. Required maintenance completed, such as:
- 24 i. Ducts cleaned
- 25 ii. Filters replaced
- 26 e. Commissioning and LEED related items and submittals
- 27 f. Owner and Maintenance Training
- 28 B. Each list shall indicate the title of the closeout requirement, the associated specification of the requirement, the
- 29 required result or deliverable, the responsible contractor(s), and a column to verify the item has been turned in
- 30 and completed.
- 31 C. The GC shall be responsible for all of the following:
- 32 1. Consolidating all the closeout lists into one master Construction Closeout Checklist.
- 33 a. The checklist shall be in a tabular data format similar to the sample below
- 34 2. Upload the completed checklist to the Contract Closeout-Miscellaneous Documents Library on the
- 35 Project Management Web Site for review.
- 36 3. Resubmit the checklist as needed after initial reviews have been completed.
- 37 D. The GC shall work with all contractors to amend the Construction Closeout Checklist throughout the execution of
- 38 the project based on changes and modifications as necessary.
- 39
- 40

<u>Title</u>	<u>Specification</u>	<u>Description</u>	<u>Responsibility</u>	<u>Completed</u>
Quality Management Observation Reports	01 45 16	All QMO reports have been properly responded to, reviewed and closed by the CPM.	All, GC	
As-Built Drawings	01 78 39	As-Built drawings have been reviewed and accepted per the specification	All, GC	
Testing and Balancing of HVAC	23 09 23	Provide final TnB reports indicating design performance has been achieved	HVAC	

42 **3.2. CONSTRUCTION CLOSEOUT REQUIREMENTS**

- 43 A. The timely submittal or completion of closeout requirements shall go hand in hand with the Progress Payment Milestone Schedule that can be found in Specification 01 29 76 Progress Payments. No payments shall be made
- 44 until all requirements for that payment have been met.
- 45 1. The GC and all major Subcontractors, Project Architect (PA)/Project Engineer (PE), and CPM, shall review
- 46 all requirements for Construction/Contract Closeout during two (2) special meetings.
- 47 a. The first meeting shall be held at the 50% Contract Total Payment milestone. This meeting shall
- 48 discuss the requirements associated with various construction/contract closeout documentation
- 49 and events when they are due with respect to progress payments.
- 50

- 1 b. The second meeting shall be held at the 70% Contract Total Payment milestone. This meeting
2 shall review the contractors progress regarding the closeout checklist, begin making plans for
3 upcoming deadlines such as scheduling training, where to put attic stock, and when they are due
4 with respect to progress payments.
5 2. The GC, PA/PE, and CPM, shall utilize the Construction Closeout checklist to ensure that all construction
6 closeout requirements have been met.

7
8 **3.3. CONSTRUCTION CLOSEOUT PROCEDURE**

- 9 A. Upon successful completion and final acceptance of all Construction Closeout Requirements the GC may submit
10 to the CPM and PA/PE the request for Final Progress Payment (100% contract total, less retainage).
11 B. The PA/PE will confirm with the design consultants, CPM, and other City of Madison staff that all requirements of
12 the Work have been completed and will do the following:
13 1. Approve the final progress payment application
14 2. Provide the required signed payment documents to the CPM
15 3. Provide the required Letter of Substantial Compliance to the following as required:
16 a. State Safety and Building Division
17 b. Local Building Inspection office
18 c. GC
19 d. CPM
20 C. The CPM shall draft the City Letter of Substantial Completion for signature by the City Engineer. This letter shall
21 state any of the following that may still be tied to the contract and/or warranty:
22 1. Indicate that the date of the letter shall also be the beginning of the Warranty period.
23 2. Indicate any allowed due outs, reasons for them, and anticipated dates of finalization.
24 a. QMO issues such as off season testing of equipment
25 b. Off season training of equipment
26 D. The GC and all subcontractors shall finalize all warranty letters associated with their Work using the date noted
27 on the City Letter of Substantial Completion, and provide the CPM with all warranties as described in
28 Specification 01 78 36 Warranties. Upon receipt and final approval of the Warranties the CPM may initiate final
29 processing of the Final Progress Payment (100% contract total, less retainage).
30

31 **3.4. CONTRACT CLOSEOUT REQUIREMENTS**

- 32 A. The GC and all sub-contractors shall follow all requirements associated with documenting contract compliance
33 and provide documentation as required or requested by DCR or PW staff. All contractors are encouraged to stay
34 current with submissions of the following documentation:
35 1. Weekly Payroll Reports no later than the Progress Payment equal to 50% of the contract total.
36 2. Employee Utilization Reports
37 3. Agent or Subcontractor Affidavit of Compliance with Prevailing Wage Rate Determination
38 4. Prime Contractor Affidavit of Compliance with Prevailing Wage Rate Determination
39 5. Documentation required for Small Business Enterprise (SBE) goals
40 6. Other documents as maybe required or requested through the Finalization Review Process
41 B. Near the Progress Payment equal to 80% of the contract total the GC shall request in writing a Finalization
42 Review. At that time DCR or PW staff shall prepare a report of all contract documentation submitted to date. A
43 list of missing items or outstanding issues will be emailed to the GC. No additional follow-up will be generated
44 by DCR or PW Staff.
45

46 **3.5. CONTRACT CLOSEOUT PROCEDURE**

- 47 A. The Contract Closeout Procedure will not begin until the Construction Closeout Procedure has been completed.
48 B. When the GC feels they have successfully met all of the Contract Closeout Requirements associated with Section
49 3.3 above the GC may submit to the request for Final Payment to the CPM.
50 C. The CPM shall sign and submit the Final Payment request for processing.
51 D. DCR and PW staff shall do a complete review of all documentation associated with item 3.3.A above.
52 E. The GC shall be notified directly by DCR or PW Staff of any documentation that may still be missing, have
53 incomplete information, or other outstanding issues. It shall be the responsibility of the GC to continue follow-
54 up with DCR and PW staff until all documentation has been successfully submitted and accepted.
55 F. When all required documentation associated with Contract Closeout has been successfully submitted and
56 accepted by DCR and PW Staff the City of Madison shall process the Final Payment of any remaining monies
57 including retainage.
58

**SECTION 01 78 13
COMPLETION AND CORRECTION LIST**

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PART 1 – GENERAL

1.1. SUMMARY

- A. The City of Madison has developed a multi-faceted Quality Management Program that begins with contract signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are delivered for the contracted Work.
 - 1. The Progress Management Web Site is a Construction Management tool that provides contractors, consultants, and staff a single on-line location for the daily operations and progression of the Work.
 - 2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it progresses. The City of Madison does not use a "Punch List" or "Corrections List" as it is typically known throughout the construction industry. The QMO process acts as an "in progress punch list". Work identified as not in compliance with the contract documents by the Owner, Owner Representatives, Owner Consultants, etc. shall be resolved immediately at the Contractor's expense. Unresolved issues will be subject to withholding of progress payment(s) until completed.
 - 3. Very stringent expectations are tied to Construction Closeout and Contract Closeout procedures. Specific milestones throughout the project need to be met and the milestones are tied to the Progress Payment Schedule.
- B. All contractors shall be required to review the specifications identified in Section 1.2 below, and other related specifications identified therein to become familiar with the terminology and expectations of this City of Madison Public Works contract.

1.2. RELATED SPECIFICATIONS

- A. Section 01 29 76 Progress Payment Procedures
- B. Section 01 31 23 Project Management Web Site
- C. Section 01 45 16 Field Quality Control Procedures
- D. Section 01 77 00 Closeout Procedures

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

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SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

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16

PART 1 – GENERAL

1.1. SUMMARY

- 19
20 A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing well
21 documented and complete Operation and Maintenance (O&M) Data related to general facility use, equipment,
22 systems, finishes, and materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and
23 Custodial Personnel) as needed.
24 B. Operation and Maintenance Data shall apply to both of the following categories except where specific
25 requirements are noted under their separate titles as follows:
26 1. Operation and Maintenance Data: Generally shall mean the owner manual that provides information on
27 start-up, shut-down, operation, troubleshooting, maintenance, parts, and other such documentation as it
28 pertains to all equipment and systems installed under the Work.
29 2. Use and Care instructions: Where applicable use and care instructions shall also be considered O&M for
30 such things as flooring, tile, partitions, and other such finishes and trim related items, installed under the
31 Work.
32

1.2. RELATED SPECIFICATIONS

- 33
34 A. Section 01 29 76 Progress Payment Procedures
35 B. Section 01 31 23 Project Management Web Site
36 C. Section 01 77 00 Closeout Procedures
37 D. Section 01 78 13 Completion and Correction List
38 E. Section 01 78 19 Maintenance Contracts
39 F. Section 01 78 36 Warranties
40 G. Section 01 79 00 Demonstration and Training
41 H. Section 01 91 00 Commissioning
42 I. Other Divisions and Specifications that may address more specifically the requirements for O&M Data.
43

1.3. QUALITY ASSURANCE

- 44
45 A. All O&M Data shall meet the requirements identified in Section 1.4 below.
46 B. All contractors shall provide O&M Data for each piece of equipment, system, or finish installed during the
47 installation of the Work. O&M Data shall be provided to the General Contractor (GC) for verification and
48 submittal.
49 C. The GC shall be responsible for receiving all required O&M Data files from all contractors for verifying that all
50 files submitted meet the requirements in Section 1.4 below.
51

1.4. O&M DATA REQUIREMENTS

- 52
53 A. O&M Data shall be provided in digital PDF format as follows:
54 1. PDF files shall be complete first generation consumer useable editions of PDF documents as provided by
55 any of the following:
56 a. Product manufacturer
57 b. Supplier of product
58 c. Product manufacturer internet site

- 1 2. Acceptable PDF files shall have the following functionality:
2 a. Word searchable
3 b. Key areas are bookmarked
4 c. Table of Contents and/or Index linked to content is preferred whenever possible.
5 3. Scanned printed material, with word searchable capabilities, saved as a PDF, is not acceptable and will be
6 rejected without further review.
- 7 B. O&M Data shall include but not be limited to the following manufacturers' published information as appropriate
8 for the equipment, system, material, or finish:
9 1. Installation instructions
10 2. Parts lists, assembly diagrams, explosion diagrams
11 3. Wiring diagrams
12 4. Start-up, shut-down, troubleshooting and other related operation procedures
13 5. Lubrication, testing, parts replacement, and other such maintenance procedures
14 6. General use, care, and cleaning instructions
15 7. Special precautions and safety requirements
16 8. A list of certified equipment vendors, service companies, parts suppliers including company name,
17 address, and phone number
18 9. A list of the recommended spare parts to have on hand at all times
19 10. A list by type of all recommended lubes, oils, packing material, and other maintenance supplies
20 11. Copies of final test reports, balance reports, and other related documentation
21 12. Warranty information for equipment and systems
22

23 **1.5. O&M DATA SUBMITTALS**

- 24 A. O&M Data shall be prepared as identified in this specification and shall be submitted for review as per the
25 schedule identified in Specification Section 01 29 76, Progress Payment Procedures.
26 B. O&M Data Draft submittals will be reviewed for content, procedure, and compliance only. A general critique
27 with recommendations for improvement will be made but re-submittals will not be required.
28 C. O&M Data Final submittals will be reviewed for content, procedure, and compliance. Re-submittals will be
29 required until such time as each submittal is accepted.
30

31 *NOTE: Acceptance of O&M Data Final submittals is required to be complete prior to scheduling and conducting owner
32 related training and construction closeout.*
33

34 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

35
36 **PART 3 - EXECUTION**

37
38 **3.1. O&M DATA PREPARATION - GENERAL**

- 39 A. All contractors shall prepare O&M Data for draft and final submission as follows:
40 1. Obtain digital PDF files for each piece of equipment, system, material or finish as described in Sections
41 1.4.A.1 and 1.4.A.2 above.
42 2. Verify that all information as described in Section 1.4.B above is included with the PDF file. Obtain
43 missing information as necessary for a complete submittal.
- 44 B. Rename each individual PDF file as follows.
45 1. Do not use special characters such as #, %, &, /, etc. These characters are reserved by the Project
46 Management Web Site software the City of Madison uses; however the under-score (or under-bar) ' _ ' is
47 an allowed character.
48 2. Use the following format and examples for renaming your file:
49 a. Format: ***Equipment name_What_METRO TRANSIT HANSON RD BUS FACILITY***
50 ***REMODEL_Contract number_Year***
51 i. *Equipment Name* represents the name of any equipment, system, material or finish as
52 designated in the Contract Documents.
53 ii. *What* represents what the file is about
54 iii. *METRO TRANSIT HANSON RD BUS FACILITY REMODEL* represents the title of the project or
55 contract. A shortened version of the title may be identified by the City Project Manager to
56 be used by all contractors.
57 iv. *Contract number* is the specific identification number the Work was bid under and appears
58 on the plan set title sheet and in each sheet title block

- 1 v. Year represents the year the contract will be closed out
- 2 b. Examples of file names
- 3 i. AHU 2_Operation Manual_Fire Admin_1234_2015
- 4 ii. CPT 2_Use and Care_MPD West_9876_2011
- 5 C. All contractors shall submit the completed digital PDF files to the GC in sufficient time for the GC to meet the
- 6 O&M Data submission deadlines as described in Specification Section 01 29 76, Progress Payment Procedures.
- 7 D. O&M Data shall be submitted and reviewed as described in sections 3.2 and 3.3 below.
- 8

9 **3.2. O&M DATA DRAFT SUBMITTAL**

- 10 A. All contractors shall prepare and submit the following for an O&M Data Draft review submittal:
 - 11 1. Prepare three (3) complete O&M Data file samples as described in section 3.1 above.
 - 12 2. Review all specifications within their Division of Work and prepare a complete O&M Data checklist listing
 - 13 all equipment, systems, materials, or finishes. Checklist shall be in tabular form similar to the example
 - 14 below and shall indicate the title (and plan identifier when applicable) of the O&M Data, the associated
 - 15 specification, and a column to verify the item has been turned in and completed.
- 16 B. The GC shall be required to review all contractors' samples and checklists for compliance with this specification
- 17 and shall return any to the originating contractor that are insufficient for re-submittal.
 - 18 1. When acceptable to the GC, they shall upload each O&M Data draft submittal file to the O&M Draft
 - 19 library on the Project Management Web Site.
- 20 C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the
- 21 O&M Data draft submittals and checklist within fifteen (15) working days as follows:
 - 22 1. Provide general critique comments by Division on O&M Data samples submitted. Critique is intended to
 - 23 provide all contractors with information on strengths and weaknesses of their submittals.
 - 24 a. Re-submittal of the O&M Data samples will not be required.
 - 25 2. Review in detail the O&M Data Checklist for completeness. Provide comments as needed.
 - 26 a. Re-submittal of the O&M Checklist will be required until accepted.
- 27

<u>Title</u>	<u>Specification</u>	<u>Completed</u>
Overhead Door Operator	08 36 00	
Air Handling Unit (AHU-3)	23 00 00	
Water Heater (WH-1)	22 30 00	

28
 29 **3.3. O&M DATA FINAL SUBMITTAL**

- 30 A. All contractors shall prepare and submit the following for an O&M Data Final review submittal:
 - 31 1. Prepare complete O&M Data files as described in Section 3.1 above according to their approved checklist
 - 32 as described in Section 3.2 above.
 - 33 2. Submit completed checklist and all final O&M Data files to the GC for final submittal review.
- 34 B. The GC shall be required to spot check all contractors' submittals for completeness against their checklists and
- 35 for compliance with this specification and shall return any to the originating contractor that are insufficient for
- 36 re-submittal.
 - 37 1. When acceptable to the GC, they shall upload each O&M Data final submittal file to the O&M Final library
 - 38 on the Project Management Web Site.
- 39 C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the
- 40 O&M Data final submittals and checklist within fifteen (15) working days as follows:
 - 41 1. Review the files submitted against the checklist and request any missing files through the GC.
 - 42 2. Review in detail all of the O&M Data files for completeness.
 - 43 a. Submittals shall be accepted or rejected as individual PDF files.
 - 44 b. Contractors shall re-submit entire O&M submittal if any portion is rejected or incomplete.
- 45

46 **3.4. CONSTRUCTION CLOSEOUT**

- 47 A. All contractors shall review Specification 01 77 00, Closeout Procedures and Specification 01 79 00
- 48 Demonstration and Training.
 - 49 1. Acceptance of all final O&M Data submittals is required prior to scheduling Demonstration and Training
 - 50 Sessions.
 - 51 2. Completion of all Demonstration and Training Sessions is required to receive the Substantial Compliance
 - 52 for Occupancy Certificate, and to begin Construction Closeout procedures.
 - 53
 - 54

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SECTION 01 78 36
WARRANTIES

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16

PART 1 – GENERAL

1.1. SUMMARY

- 19
20 A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing all
21 Warranties and Guarantees related to the Work, workmanship, materials, equipment, and other such items
22 required by the Construction Documents.
23 B. Manufacturers’ disclaimers and limitations on product warranties do not relieve any contractor of the warranty on
24 the Work that includes the product.
25 C. Manufacturers’ disclaimers and limitations on product warranties do not relieve suppliers, manufacturers and
26 any contractor required to provide special warranties under the contract documents.
27

1.2. RELATED SPECIFICATIONS

- 28
29 A. Section 01 29 76 Progress Payment Procedures
30 B. Section 01 31 23 Project Management Web Site
31 C. Section 01 77 00 Closeout Procedures
32 D. Section 01 78 23 Operation and Maintenance Data
33 E. Section 01 91 00 Commissioning
34 F. Other Divisions and Specifications that may address more specifically the requirements for Warranties related to
35 the installation of all items and equipment installed under the execution of the Work.
36

1.3. DEFINITIONS

- 37
38 A. See specification 01 77 00 for the definitions of the following terms that may also be used in this specification:
39 1. Substantial Compliance
40 2. Certificate of Occupancy
41 3. Certificate of Substantial Completion
42 4. Construction Closeout
43 5. Contract Closeout
44 B. Emergency Repair: The Owner or Owner Representative reserves the right to make emergency repairs as
45 required to keep equipment or materials in operation or to prevent damage to property and injury to persons
46 without voiding the contractors warranty or bond or relieving the contractor of their responsibilities during the
47 warranty period.
48 C. Installer: The company or contractor hired to install a finished product that was manufactured and supplied
49 specifically for the Work within this contract. The Installer may or may not be the same company that supplied
50 the product. See the definition for supplier.
51 D. Supplier: Any company that makes a specific finished product for the Work from information within the Contract
52 Documents. Examples of suppliers would include custom cabinets, steel stairs and railings, etc. A supplier would
53 not be a company that distributes items manufactured by others such as an electrical or plumbing supplier.
54 E. Warranty: A written guarantee from the manufacturer to the owner on the integrity of a product and its
55 installation, and the manufacturers’ responsibility to repair or replace the defective product or components
56 within a specified time from the date of ownership. Warranty may also be used interchangeably with
57 Guarantee. The following warranty types may be part of any specification within the Work associated with the
58 Construction Documents:

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1. Expressed Warranty: A warranty that provides specific repair or replacement for covered components of a product over a specified length of time.
 2. Implied Warranty: A warranty that is not stated explicitly by a seller or manufacturer that the product is merchantable and fit for the intended purpose.
 3. Standard Product Warranty: Preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner. Standard warranties may be for any amount of time but shall not be for anything less than one (1) year from the warranty date.
 4. Special Warranty: A written warranty required by the Contract Documents either to extend the time limit provided under a standard warranty or to provide greater rights to the Owner.
- F. Warranty Date: The effective date that begins all warranty periods required for products, installations, and work-manship associated with the execution of the Work for this contract. The Warranty Date shall be set by the CPM.
- G. Related Damages and Losses: When correcting failed or damaged Warranted Work, remove and reinstall (or replace if necessary) the construction that has been damaged as a result of the failure or the construction that must be removed and replaced to obtain access for the correction of Warranted Work.
- H. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected reinstate the warranty by a new written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation unless specifically noted otherwise in a specification.
- I. Replacement Cost: All costs that may be associated with Work being replaced under warranty including but not limited to the following:
1. Related damages and losses
 2. Labor, material and equipment
 3. Permits and inspection fees
 4. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.
- J. Replacement Work: All materials, products, required labor, and equipment necessary to replace failed or damaged warranted to an acceptable condition that complies with the requirements of the original Construction Documents.
- K. Owners Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, and remedies.
1. Rejection of Warranties: The Owner reserves the right to reject any warranty and to limit the selection of products with warranties not in conflict with the requirements of the contract documents.
 2. Where the Contract Documents require a Special Warranty or similar commitment on the Work or product, the Owner reserves the right to refuse acceptance of the Work until the Contractor presents evidence the entities required to countersign such required commitments have done so.

40 **1.4. GENERAL CONTRACTORS RESPONSIBILITIES**

- 41 A. The General Contractor (GC) shall be responsible to remedy, at their expense, any defect in the Work and any
42 damage to City owned or controlled real or personal property when the damage is a result of:
- 43 1. The GC's failure to conform to Contract Document requirements.
 - 44 a. Any substitutions not properly approved and authorized may be considered defective.
 - 45 2. Any defect in workmanship, materials, equipment, or design furnished by the GC or Sub-contractors.
 - 46 B. All warranties as described in this specification and these Contract Documents shall take effect on the date
47 established by the CPM, as noted in Section 1.3F above.
 - 48 1. All warranties shall remain in effect for one (1) year thereafter unless specifically stated otherwise in the
49 Contract Documents or where standard manufacturer warranties are greater.
 - 50 C. The GC's warranty with respect to Work repaired or replaced, including restored or replaced Work due to
51 damage, will run for one (1) year from the date of Owner Acceptance of said repair or replacement.
 - 52 1. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its
53 anticipated useful service life.
 - 54 D. Warranty Response
 - 55 1. See Section 3.5 of this specification.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. WARRANTY CHECKLIST

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Warranty Requirements to the GC.
- B. Each list shall indicate the title (and plan identifier when applicable) of the warranted item, the associated specification of the warranted item, the terms of the warranty (years), and a column to verify the item has been turned in and completed.
- C. The GC shall be responsible for all of the following:
 - 1. Consolidating all the warranty lists into one master Warranty Checklist.
 - a. The checklist shall be in a tabular data format similar to the sample below.
 - 2. Upload the completed checklist to the Submittal Library on the Project Management Web Site for review. See Specification 01 33 23 Submittals for more information on this procedure.
 - 3. Resubmit the schedule as needed after initial reviews have been completed.
- D. The GC shall work with all contractors to amend the Warranty Checklist throughout the execution of the project based on changes and modifications as necessary.

<u>Title</u>	<u>Specification</u>	<u>Terms</u>	<u>Completed</u>
Overhead Door Operator	08 36 00	MFR 2yr	
Exterior Bench and Trash Receptacles	12 93 00	MFR 3 year warranty on finish	
Kitchen Sink (SK-1)	22 42 00	MFR 5 year	
Disposal (D-1)	22 42 00	MFR 7 year parts and in-home service	
Toilet (WC-1)	22 42 00	MFR 1 year limited	

3.2. LETTERS OF WARRANTY

- A. All letters of warranty shall be in a typed letter format and provide the following information:
 - 1. The letter shall be on official company stationary including company name, address, and phone number.
 - 2. Indicate METRO TRANSIT HANSON RD BUS FACILITY REMODEL, contract number, and contract address the warranty is for on the reference line.
 - 3. Provide a description of the warranty(ies) being provided.
 - a. Include Division, Trade, or Specification information as necessary.
 - b. Only combine warranties of related Divisional Work together. Create new letters for additional Divisions as necessary.
 - 4. Indicate the effective Warranty Date. As noted in Section 1.3.F above, the Warranty Date shall be the date the Certificate of Substantial Completion was signed by the City Engineer.
 - 5. Contractor Letters of Warranty shall only be signed by a principal officer of the company.
 - 6. After signing the letter provide the GC with a high quality color scanned image in PDF format and the original signed letter.
- B. The GC shall be responsible for the Final Warranty submittal as identified in Section 3.4 below.
- C. The GC shall obtain letters of warranty from all of the following:
 - 1. The General Contractor shall provide warranty letters for all Work that was self performed under the contract documents, identify all trades or Divisions of Work.
 - 2. All Sub-contractors shall provide warranty letters for Work performed under the contract documents; identify all trades or Divisions of Work.
 - 3. Suppliers, as required by other specifications within the Construction Documents where the manufacture of a specific product unique to the Work of this contract was required.
 - a. The terms and conditions of the Supplier Letter of Warranty shall be as defined by the specifications associated with the Work but shall not be less than the industry standard of repair, or replace defective materials and workmanship within one (1) year of the warranty date.
 - b. When the supplier is also the installer a single written letter may be submitted identifying both the warranty for the manufacture of the product and the warranty for the installation of the product.
 - 4. Installers as required by other specifications within the Construction Documents where the installation of a specific product unique to the Work of this contract was required.

- 1 1. The terms and conditions of the Installer Letter of Warranty shall be as defined by the
- 2 specifications associated with the Work but shall not be less than the industry standard of repair,
- 3 or replace defective materials and workmanship associated with the installation of the product
- 4 within one (1) year of the warranty date.
- 5 5. Special Letters of Warranty shall be required from any contractor, supplier, installer or manufacturer who
- 6 agrees to provide warranty services required by any Division Specification in excess of their Standard
- 7 Product Warranty.
- 8

9 **3.3. STANDARD PRODUCT WARRANTY**

- 10 A. All contractors shall be responsible for collecting and providing copies of all standard product warranties for
- 11 commercially available products purchased and installed under this contract.
- 12 B. Only one copy of the manufacturers' standard warranty needs to be submitted as representative for all
- 13 quantities of the same model number used throughout the Work.
- 14 C. Provide the manufacturers certificate, letter, or other standard documentation for each Standard Product
- 15 Warranty submitted as follows:
 - 16 1. Whenever possible a PDF version of the document shall be used.
 - 17 a. If a PDF version is used all additional information shall be completed using simple PDF editing
 - 18 tools such as text boxes, highlight, etc.
 - 19 b. If a PDF version is not available and an original document is furnished the additional information
 - 20 shall be neatly hand written and highlighted on the document in such a fashion so that it does not
 - 21 obscure any part of the written warranty.
 - 22 2. Provide the following additional information on each warranty document:
 - 23 a. Contract warranty date.
 - 24 b. Provide the manufacturer name and model number of the product if not specified within the
 - 25 warranty.
 - 26 i. Where the manufacturer name and model number is specified within the warranty it shall
 - 27 be highlighted for visibility.
 - 28 c. Provide the plan identifier (LAV-1, WC-2, etc) when applicable.
 - 29 D. Each completed warranty shall be saved as a digital PDF. The file shall be named using the specification number
 - 30 and item description. I.E. 22 42 00 Toilet (WC-1).pdf
 - 31 a. Where an original certificate was furnished provide a high quality colored scan of the completed
 - 32 document with the additional information. Save the scanned image in PDF format and use the
 - 33 same naming convention as indicated above.
 - 34 E. Provide all PDF files and any original documents to the GC for final consolidation to be provided to the Owner.
- 35

36 **3.4. FINAL WARRANTY SUBMITTAL**

- 37 A. The GC shall receive all required warranties (digital PDF and any original documents) from all contractors,
- 38 suppliers, installers and manufacturers.
- 39 B. The GC shall inventory all received warranties with the Warranty Submittal List to ensure all required warranties
- 40 have been received and all warranty periods are correct according to the specifications.
- 41 C. Provide with each Operation and Maintenance Manual a complete copy of any associated warranty.
- 42 D. Scan all warranties into a single organized electronic PDF file as follows:
 - 43 1. Organize the PDF file into an orderly sequence based on the table of contents of the Specifications.
 - 44 2. Provide a typed Table of Contents for the entire file at the front of the document.
 - 45 3. Provide bookmarks and links to each individual PDF to enable quick navigation through the PDF
 - 46 document.
- 47 E. Upload the warranty submittal to the appropriate document library on the Project Management Web Site for
- 48 review by the Project Architect (PA)/Project Engineer (PE) and CPM.
- 49 F. Correct any deficiencies or omissions and resubmit as necessary.
- 50

51 **3.5. WARRANTY NOTIFICATION, RESPONSE, EXECUTION AND FOLLOW-UP**

- 52 A. Warranty Notification:
 - 53 1. The City of Madison, Project Management Web Site, uses an email notification system for all warranty
 - 54 related issues. The GC will be required to provide, and keep current during the warranty period, a
 - 55 minimum of two (2) email addresses and phone numbers of current employees to receive email
 - 56 notifications and provide response regarding Work associated with these construction documents.
 - 57 a. In the event a Warranty Issue is deemed by the City of Madison to be an emergency, the GC shall
 - 58 first receive a phone call with a follow-up email from the Project Management Web Site.

- 1 b. The Contract Closeout-Warranty Issue Library on the Project Management Web Site uses a form
2 for each warranty issue that is logged into the system.
- 3 i. The GC shall open each warranty issue form, review the issue description and any attached
4 documentation or photos.
- 5 ii. The GC shall also notify any other sub-contractor, supplier, or installer that may be
6 required to review the warranty issue.
- 7 B. Warranty Response:
- 8 1. The GC shall upon notification by the City of Madison provide warranty response as follows:
- 9 a. Critical Systems or equipment: Where damage to equipment and other building components, or
10 injury to personnel is probable provide immediate emergency shut-down information and an on-
11 site response team as soon as possible but in no case shall on-site response exceed 24 hours.
- 12 b. For non-critical responses where damage or injury is unlikely provide on-site response no later
13 than the next business day.
- 14 c. Where Technical Assistance support is part of the written warranty provide all assistance
15 necessary via phone, text, or internet systems as indicated by the warranty. If issues cannot be
16 resolved provide on-site response no later than the next business day.
- 17 d. If the request cannot be supported in sufficient time as outlined above the Owner (or Owner
18 Representative) reserves the right to contact other contractors or service companies having
19 similar capability to expedite the repair or replacement and shall invoice all associated costs to
20 the Owner back to the GC.
- 21 C. Warranty Execution:
- 22 1. The GC shall provide all repairs or replacements as necessary to restore broken or damaged Work to the
23 original level of acceptance as intended by the Contract Documents.
- 24 a. Provide all materials, equipment, products, and labor necessary to complete the repair or
25 replacement associated with the Warranty Issue.
- 26 b. Provide all cleaning services as may be required before, during, and after the repair or
27 replacement as per Specification 01 74 13 Progress Cleaning.
- 28 c. Provide any protection necessary for existing construction as per Specification 01 76 00 Protecting
29 Installed Construction
- 30 d. Provide new letters of warranty when required.
- 31 D. Warranty Follow-up:
- 32 1. Logged Warranty Issues:
- 33 a. The GC shall provide complete documented responses of all logged Warranty Issues. Responses
34 shall provide a description of work completed, by who, inclusive dates, and photos of completed
35 or repaired work.
- 36 i. Provide call back response if work is not acceptable.
- 37 b. The City Project Manager shall review the submitted response documentation and do a field
38 inspection if necessary.
- 39 i. If work is not acceptable, contact GC to review details and expectations of the repair as
40 needed.
- 41 ii. If work is acceptable close the Warranty Issue.
- 42 2. Quarterly Warranty Reviews:
- 43 a. The GC shall be responsible for scheduling quarterly on-site review with all of the following:
- 44 i. City Project Manager, and other City staff as needed
- 45 ii. Owner and Owner Tenant Representative
- 46 iii. Commissioning Agent (CxA)
- 47 iv. Plumbing, Heating, Electrical Sub-contractors
- 48 v. Other Sub-contractors that may be responsible for open Warranty issues
- 49 b. Quarterly reviews shall be scheduled at 3 months, 6 months, and 11 months after the effective
50 date of the warranty. The review meetings shall:
- 51 i. Review the status of all open Warranty Issues, determine course of action and estimated
52 date of completion.
- 53 ii. In the appropriate quarter, provide shut-down, start-up, testing, and training of off-season
54 equipment as required by the contract documents.
- 55 iii. The 11th month review shall review all open Warranty Issues, final plan for resolution, and
56 all Warranty Issues where a new letter of warranty may have been issued.
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END OF SECTION

**SECTION 01 78 39
AS-BUILT DRAWINGS**

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18

PART 1 – GENERAL

1.1. SUMMARY

- 22 A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they
23 pertain to City of Madison contract procedures regarding the accurate recording of the Work associated with the
24 execution of this contract. This shall include but not be limited to work that will be hidden, concealed, or buried.
25 B. Each contractor shall be responsible for maintaining an accurate record of all installations, locations, and
26 changes to the contract documents during the execution of this contract as it may relate to their specific division
27 or trade.
28 C. The General Contractor (GC) shall be responsible for ensuring all contractors provide as-built record information
29 to the Master As-Built Document Set as described in this specification.
30

1.2. RELATED SPECIFICAITONS

- 32 A. 00 31 21 Survey Information
33 B. 01 26 13 Request for Information
34 C. 01 31 23 Construction Bulletin
35 D. 01 32 33 Photographic Documentation
36 E. 01 26 63 Change Orders
37 F. 01 29 76 Progress Payment Procedures
38 G. 01 31 23 Project Management Web Site
39 H. 01 33 23 Submittals
40 I. 01 77 00 Closeout Procedures
41 J. 01 91 00 Commissioning
42 K. Other Divisions and Specifications that may address more specifically the requirements for field recording the
43 installation of all items associated with the execution of this contract by Division or Trade.
44

1.3. RELATED DOCUMENTS

- 46 A. Other related documents shall include but not be limited to the following:
47 1. Bidding documents including drawings, specifications, and addenda.
48 2. Required regulatory documents of conditional approval.
49 3. Field orders, verbal or written by inspectors having regulatory jurisdiction.
50 4. Shop drawings and installation drawings.
51

1.4. PERFORMANCE REQUIREMENTS

- 53 A. The GC shall be responsible for maintaining the “Master As-Built Document Set” in the job trailer at all times
54 during the execution of this contract. This document set shall include all of the following:
55 1. Master As-Built Plan Set
56 2. Master As-Built Specification Set
57 3. Other Document Sets

- 1 B. The GC shall designate one person of the GC staff to be responsible for maintaining the Master As-Built
2 Document Set at the job trailer. This shall include, posting updates, revisions, deletions and the monitoring of all
3 contractors posting as-built information as described in this specification.
4 C. All contractors shall use this specification as a general guideline regarding the requirements for documenting
5 their completed Work. Contractors shall explicitly follow additional specification requirements within their own
6 Division of Trade as it may apply to this specification.
7

8 **1.5. QUALITY ASSURANCE**

- 9 A. The GC shall be responsible for all of the following:
10 a. Spot checking all sub-contractors field documents to insure daily information is being recorded as
11 work progresses.
12 b. Discuss as-built recording to the plan set at weekly job meetings with all sub-contractors on site.
13 c. Schedule time with sub-contractors in the job trailer for recording as-built information to the plan
14 set.
15 d. Insure that all sub-contractors are providing clear and accurate information to the plan set in a
16 neat and organized manner.
17 e. Insure sub-contractors who have completed work have finalized recording all as-built information
18 to the plan set before releasing them from the project site.
19 B. The Project Architect, the City Project Manager, Commissioning Agent and other design team staff will perform
20 random checks of the Master As-Built Document Set during the execution of this contract to ensure as-built
21 information is being recorded in a timely fashion as the Work progresses. An updated and current Master As-
22 Built Document Set is a stipulation for approval of the progress payment.
23

24 **PART 2 – PRODUCTS**

25 **2.1. OFFICE SUPPLIES**

- 26 A. The GC shall provide a sufficient supply of office products in the job trailer at all times for all contractors to use in
27 recording as-built information into the plan set. This shall include but not be limited to the following:
28 a. Red ink pens, medium point. Pens that bleed through paper, markers, and felt tips will not be
29 accepted.
30 b. The use of highlighters is acceptable. Assign colors to various trades for consistency in recording
31 information.
32 c. Straight edges of various lengths for drawing dimension, extension and other lines.
33 d. Civil and Architectural scales
34 e. Clear transparent, non-yellowing, single sided tape.
35 f. Correction tape or correction fluid for correcting small errors.
36
37

38 **PART 3 - EXECUTION**

39 **3.1. FIELD DOCUMENT AS-BUILTS**

- 40 A. The GC and all Sub-contractors shall be responsible for keeping their own field set of as-built documents
41 including plans, specifications and published changes.
42 B. Field sets shall be kept dry and in good condition at all times.
43 C. No Work shall be buried, covered, or hidden, by any additional Work, regardless of Contractor or Trade, until
44 locations of all materials and equipment has been properly documented as described below.
45 D. All contractors shall be required to record the following as-built information:
46 a. Notes on the daily installation of materials and equipment.
47 b. Sketches, corrections, and markups indicating final location, positioning, and arrangement of
48 materials and equipment such as pipes, conduits, valves, cleanouts, pull boxes and other such
49 items. Note all final locations on plan sheets, indicate dimension off identifiable building features.
50 Riser diagrams need only be corrected for significant changes in locations, routing or
51 configuration.
52 i. The use of photographs in lieu of hand drawn sketches is acceptable.
53 ii. Photos shall be taken according to Specification 01 32 33 Photographic Documentation
54 iii. Print photo and markup with dimensions or notes as necessary.
55 c. Identify by the use of existing plan symbology and notes the size, type, quantity, and use as
56 applicable of materials such as pipes, valves, conduits, etc.
57

- 1 d. Note whether horizontal runs are below slab or above ceiling, include dimensions above or below
- 2 finished floor elevation.
- 3 E. All contractors shall be responsible for transferring the information from their field set of documents to the
- 4 Master As-Built Plan Set kept in the GC job trailer. See Section 3.3.D. below for the proper procedure.
- 5 F. All contractors shall update the GC Master Plan Set as often as necessary, but not less than once per work week.
- 6

7 **3.2. SITE SURVEY AS-BUILT**

- 8 A. The Land Surveyor Sub-Contractor shall provide digital as-built information including but not be limited to the
- 9 following:
- 10 a. For underground buried utility laterals and services of all types locate all of the following that may
- 11 apply:
- 12 i. Connection points at all mains
- 13 ii. Storm discharge points to open air
- 14 iii. All corners and bends regardless of angle, large radius sweeps shall have multiple point
- 15 locations sufficient to define the sweep.
- 16 iv. All vertical drops
- 17 v. All wells
- 18 vi. Private buried utilities such as buried electrical cables, irrigation systems, etc.
- 19 v. Other information that may need to be located in the future by the owner prior to digging
- 20 b. Record all surface features including but not limited to the following:
- 21 i. Building corners, pavement edges, and other permanent structural features.
- 22 ii. All surface covers for inlets, catch basins, cleanouts, access structures, curb stops and
- 23 other such devices.
- 24 iii. Other permanent surface features such as hydrants, lamp posts, and other permanent site
- 25 amenities.
- 26 c. The following data shall be recorded while locating items in sub-sections 3.2.a and 3.2.b above:
- 27 i. Flow lines at both ends of pipes
- 28 ii. Pipe sizes and material types
- 29 iii. Rim elevations for all covers
- 30 iv. Sump elevations and invert elevations of all structures
- 31 v. Spot elevations for all pads, driveways, walks, stoops, and floors
- 32 B. The Surveyor shall provide the final digital as-built on a media and in a format specified in Specification 00 31 21
- 33 Survey Information to the GC for turn in to the Project Architect and the Civil Engineer.
- 34 C. The Surveyor shall provide two printed as-built site plans to the GC for inclusion in the Master As-Built Plan Set
- 35 as follows:
- 36 1. One sheet to show all features (but not contour information) with text neatly organized for each item
- 37 identified.
- 38 2. One sheet showing contours, contour labels, and features from item 1 above, but with no additional text.
- 39

40 **3.3. MASTER AS-BUILT DOCUMENT SET**

- 41 A. The GC shall be responsible for maintaining the Master As-Built Document Set in the job trailer at all times.
- 42 1. The Master As-Built Plan Set (Plan Set) shall begin with one complete bid set of drawings and any
- 43 additional sheets that were supplied by published addenda during the bidding process. The cover sheet
- 44 shall be titled as the "Master As-Built Plan Set" in large bold red letters approximately 2" in height and
- 45 shall not be used for any other purpose.
- 46 a. The Plan Set shall be kept dry, legible, and in good condition at all times.
- 47 b. The Plan Set shall be kept up to date with new revisions within two (2) working days of
- 48 supplemental drawings being issued. Revisions shall be posted as follows:
- 49 i. Insert new, revised sheets into the plan set. Void old sheets but do not remove them from
- 50 the plan set. Indicate date received and what document (RFI, CB, CO, etc) caused the
- 51 change.
- 52 ii. Insert new, revised individual details into the plan set. Void old details, tape new details
- 53 over the old details with a "tape hinge" to allow them to be viewed. Indicate date
- 54 received and what document (RFI, CB, CO, etc) caused the change.
- 55 iii. Add new details in appropriate white space on relevant sheets. If no space is available use
- 56 the back side of the previous sheet or insert a new sheet. Indicate date received and what
- 57 document (RFI, CB, CO, etc) caused the change.

- 1 c. The Plan Set shall be available at anytime for easy reference during progress meetings and for
2 emergency location information of new work already completed.
- 3 2. The Master As-Built Specification Set (Spec Set) shall begin with one complete bid set of specifications
4 and any additional specifications that were supplied by published addenda during the bidding process.
5 The Spec Set shall be provided in three "D" ring type binders of sufficient thickness to accommodate the
6 specification set. Multiple binders are allowed as necessary. Label the front cover and binding edge with
7 "Master As-Built Specifications" in bold red letters. Provide other information as necessary to distinguish
8 the contents of multi-volume sets.
- 9 a. The Spec Set shall be kept dry, legible, and in good condition at all times.
10 b. The Spec Set shall be kept up to date with new revisions within two (2) working days of
11 supplemental drawings being issued.
- 12 c. The Spec Set shall be available at anytime for easy reference during progress meetings.
- 13 3. Other Document Sets may be kept at the GCs option in three "D" ring type binders of sufficient thickness
14 to accommodate the documentation. Other documentation sets may include but not be limited to RFIs,
15 CBs, COs, etc.
- 16 C. The Land Surveyor Sub-Contractor shall be required to use digital surveying for all exterior site surveying, and
17 provide deliverable digital as-builts as specified in Specification 00 31 21 Survey Information. As soon as practical
18 the surveyor shall provide the GC with a preliminary copy of installed buried utilities for inclusion with the plan
19 set in the job trailer. The surveyor shall provide final digital as builts as per section 3.2 above.
- 20 D. All contractors shall be responsible for updating the Plan Set from their field sets at least once per work week.
21 Updates shall include but not be limited to the following procedures:
- 22 a. All updates shall be done only in red ink. Place a "cloud" around small areas of correction to call
23 attention to the change.
- 24 b. Whenever possible place general work notes, field sketches, supplemental details, photos, and
25 other such information on the reverse side of the preceding sheet. Installation notes including
26 dates shall be kept neatly organized in chronological order as necessary.
- 27 c. Accurately locate items on the plan set as follows:
- 28 i. For items that are located as dimensioned provide a check mark or circle indicating the
29 dimension was verified.
- 30 ii. For items that are within 5 feet of the location indicated on the plans leave as shown and:
- 31 • Provide correct dimensions to existing dimension strings or,
32 • Accurately locate with new dimension strings
- 33 iii. For items that are more than 5 feet from the location indicated on the plans
- 34 • Accurately draw the items in the new location as installed and,
35 • Accurately locate with new dimension strings and,
36 • Note that the existing location is void.
- 37 d. Include dimensioned locations for items that will be buried, concealed, or hidden in the ground,
38 under floors, in walls or above ceilings.
- 39 i. Dimensions shall be pulled from identifiable building features, not from centers of columns
40 or other buried features.
- 41 ii. When necessary pull more dimensions as needed from opposing directions to properly
42 locate single items.

3.4. AS-BUILT REVIEW AND ACCEPTANCE

- 45 A. The GC shall provide the Master As-Built Plan Set to the Project Architect (PA)/Project Engineer (PE), the City
46 Project Manager (CPM), the Commissioning Agent (CxA) and other design team staff for content review prior to
47 the Progress Payment Milestone indicated in Specification 01 29 76 Progress Payment Procedures. The
48 submitted plan set shall include the digital survey information produced under Section 3.2 above.
- 49 1. If the plan set is not approved:
- 50 a. The PA/PE and CPM shall only be required to generalize deficiencies by trade there shall be no
51 requirement or expectation to generate a "punch list" of required corrections.
- 52 b. The GC and Sub-contractors as necessary shall be responsible for inspecting the installation and
53 correcting the drawings as needed.
- 54 c. The GC shall re-submit the plan set for review.
- 55 2. If the plan set is approved the PA/PE shall take possession of the plan set to be used in providing the
56 owner with digital CAD record drawings. Upon completion of transferring the information to CAD the
57 PA/PE shall provide the Owner with CAD record drawings, record PDFs, and the Master As-Built Plan Set.
- 58

- 1 **3.5. CHANGES AFTER ACCEPTANCE**
2 A. No Contractor shall be responsible for making changes to the As-Built record documents after acceptance by the
3 PA/PE and CPM except when necessitated by changes resulting from any Work made by the Contractor as part
4 of their guarantee.
5

6
7 **END OF SECTION**
8
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**SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIALS**

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7 1.3. DEFINITIONS 1
8 1.4. PERFORMANCE REQUIREMENTS 1
9 1.5. QUALITY ASSURANCE 1
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11 PART 3 - EXECUTION 2
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13 3.2. LABELING 2
14 3.3. INVENTORY 2
15 3.4. STORAGE 3
16 3.5. CLOSEOUT PROCEDURE 3
17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they
22 pertain to City of Madison contract procedures regarding spare parts, special tools, special materials, and extra
23 materials.
24 B. Each contractor shall be responsible for knowing the specific requirements of their Division Specifications as they
25 may relate to the general information provided in this specification.
26 C. The General Contractor (GC) shall be responsible for ensuring all contractors provide spare parts and extra
27 materials as described in this specification.
28

1.2. RELATED SPECIFICAITONS

- 30 A. 01 29 76 Progress Payment Procedures
31 B. 01 31 23 Project Management Web Site
32 C. 01 77 00 Closeout Procedures
33 D. Other Divisions and Specifications that may address more specifically how to proceed with spare parts, special
34 tools, special materials, and extra materials.
35

1.3. DEFINITIONS

- 37 A. Spare Parts: Any component of a product or assembly that comes pre-packaged or was specially ordered for the
38 explicit use of the product or assembly. This shall include but not be limited to fastening devices, mounting
39 brackets, replacement parts, wheels, pulleys, wiring, alternate assembly pieces, etc.
40 B. Special Tools: Any tool of any kind that was pre-packaged or specially ordered, and is required to be used for the
41 installation or maintenance of an installed product or assembly as part of this contract.
42 C. Special Materials: Any oil, lubricant, glue, touch-up paint, or other such material that comes pre-packaged or
43 was specially ordered and is required to be used for the installation or maintenance of an installed product or
44 assembly as part of this contract.
45 D. Extra Materials (Attic Stock): Any surplus materials in new and useable condition that was installed a part of this
46 contract. Attic Stock shall include but not be limited to the following: ceiling tiles, paint, stain, floor coverings,
47 ceramic tiles, light bulbs/lamps, filters, strainers, etc. Attic Stock shall include partially opened bulk items and
48 additional unopened quantities as directed by other specifications.
49

1.4. PERFORMANCE REQUIREMENTS

- 51 A. All contractors shall be responsible for consolidating spare parts, special tools, special materials, and attic stock
52 as it pertains to the specific Work within their Division or Trade.
53 B. All contractors shall use this specification as a general guideline regarding the requirements for turning spare
54 parts, special tools, special materials, and attic stock over to the owner. Contractors shall explicitly follow
55 specification requirements within their own Division of Trade.
56

1.5. QUALITY ASSURANCE

- 58 A. The General Contractor (GC) shall be responsible for all of the following:

- 1 1. Coordinate the location for and the delivery of all spare parts, special tools, special materials, and attic
2 stock being provided by all contractors under this contract to one centralized location as designated by
3 the Owner.
4 2. Verify that all items being delivered are:
5 a. Clean, new, and in a usable condition.
6 b. Properly sealed, protected, and labeled
7 c. Properly documented
8

9 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

10
11 **PART 3 - EXECUTION**

12
13 **3.1. PACKAGING**

- 14 A. Whenever possible all surplus items should remain in their original packaging such as parts envelopes.
15 B. Package small parts in re-sealable plastic bags (Ziploc) or envelopes with clasp fasteners. Do not use envelopes
16 that seal with glue or tape envelopes closed. Do not leave packaging unsealed.
17 C. Package like parts together for products or assemblies. I.E. keep all spare parts for flushometers together.
18 D. Many small packages may be grouped together into a larger container by trade.
19 E. Do not use unrelated boxes or containers for packaging spare items. I.E. do not use a light fixture box for spare
20 breakers, or flushometers parts.
21

22 **3.2. LABELING**

- 23 A. Whenever possible the original labeling indicating part numbers and other pertinent information shall remain on
24 the original packaging.
25 B. If original labeling is not available the contractor shall label all parts and packages using tape or labels and
26 permanent black markers. Tape or labels being used shall absorb the permanent marker without bleeding or
27 allowing ink to be smeared or rubbed off.
28 C. Labels shall include the name of the product or equipment the item belongs to, part number and/or name, and
29 any other information that would assist maintenance personnel in identifying the piece and related product.
30 D. Labels shall include plan or specification designations (WC-1, LAV-3, DF-2, CPT-1, etc) that identify the particular
31 product or finish material it represents.
32 E. Labels for parts stored in clear re-sealable plastic bags may be placed inside the bag. Label shall face out and be
33 able to be read from one side. Multiple bags shall be numbered individually for identification.
34 F. Label the outside of large containers with the trade name (Plumbing, Electrical, etc).
35

36 **3.3. INVENTORY**

- 37 A. All contractors shall provide the GC with complete inventories of all spare parts, special tools, special materials,
38 and attic stock that they are providing at the end of the contract. The inventories shall be organized as follows:
39 1. The cover sheet shall indicate the Contractors name, address, phone number, identify that the document
40 is the "Spare Parts and Extra Materials Inventory", and identify the Division or Trade the inventory is for.
41 2. Provide an inventory in a tabular format of all items being provided under this and other specifications.
42 The minimum information to be provided for each item on the inventory shall be as follows:
43 a. Bag or container number, all items of one bag or container shall be grouped together on the
44 inventory
45 b. Item description
46 c. Item size (if applicable)
47 d. Total quantity provided
48 e. Identify if item is a spare part, tool, special material, or attic stock
49 B. The GC shall consolidate inventories from all sub-contractors into one tabular data sheet organized by Division or
50 Trade of Work.
51 1. Upon completing the consolidated list the GC shall upload the completed inventory to the Contract
52 Closeout-Attic Stock Library on the Project Management Web Site.
53 2. The GC shall notify the Project Architect and City Project Manager that the scans have been uploaded.
54 3. Consulting Staff and Owner Staff shall review the inventories prior to Final Review to verify that minimum
55 required quantities have been met. Deficiencies shall be noted and returned back to the GC for
56 corrective action.
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3.4. STORAGE

- A. Prior to the 80% Progress Payment milestone the GC shall coordinate with the City Project Manager and Maintenance Personnel where spare parts, special tools, special materials, and attic stock shall be stored.
- B. The GC shall instruct all contractors as to the location and proper storage procedures.
- C. The GC shall be responsible for ensuring the storage area is kept neat and orderly as follows:
 - 1. Like items are stored together by material, product, or trade as necessary.
 - 2. Liquids are stored in sealable containers and the lids have been properly installed to prevent drying out, spillage, etc.
 - 3. All labels are clearly visible and provide the required information.
- D. Large items shall be stored so as not to damage other items. Do not stack heavy items or items with distinct shapes/outlines on softer items that may get crushed or imprinted.

3.5. CLOSEOUT PROCEDURE

- A. Prior to the 90% Progress Payment milestone the GC shall review all attic stock already stored by the contractors to ensure the following:
 - 1. Materials are stored in the proper location(s).
 - 2. All boxes, containers and items are properly labeled according to the submitted/approved inventory.
 - 3. Quantities are correct according to the submitted/approved inventory.
- B. The GC shall ensure that all deficiencies are corrected prior to conducting Demonstration and Training Sessions.
- C. The GC shall review with Maintenance Staff all inventories and labeling during the scheduled Demonstration and Training Sessions.
- D. Any discrepancies associated with Attic Stock shall be resolved and verified prior to the CPM releasing the 90% CT progress payment.

END OF SECTION

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**SECTION 01 79 00
DEMONSTRATION AND TRAINING**

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16

PART 1 – GENERAL

1.1. SUMMARY

- 19
20 A. The purpose of this specification is to provide clear responsibilities and guidelines related to providing
21 Demonstration and Training (D&T) Sessions related to general facility use, equipment, systems, finishes, and
22 materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as
23 needed.
24 B. All D&T shall be coordinated through the General Contractor (GC), Project Architect (PA)/Project Engineer (PE)
25 and City Project Manager (CPM), and will be based on or customized to the needs of City of Madison Staff being
26 trained. New equipment and systems may have complete D&T sessions as described in this specification while
27 equipment or systems staff is familiar with may have sessions more focused on maintenance only.
28

1.2. RELATED SPECIFICATIONS

- 29
30 A. Section 01 29 76 Progress Payment Procedures
31 B. Section 01 78 13 Completion and Correction List
32 C. Section 01 78 19 Maintenance Contracts
33 D. Section 01 78 23 Operation and Maintenance Data
34 E. Section 01 78 36 Warranties
35 F. Section 01 78 39 As-Built Drawings
36 G. Section 01 78 43 Spare Parts and Extra Materials
37 H. Section 01 91 00 Commissioning
38 I. Other Divisions and Specifications that may address more specifically the requirements for D&T sessions related
39 to the installation of all items and equipment installed under the execution of the Work.
40

1.3. QUALITY ASSURANCE

- 41
42 A. All contractors shall have the responsibility of preparing for and conducting D&T sessions as determined by this
43 and other Division or Trade related specifications, Owner Operation and Maintenance Manuals, and other such
44 documentation related to the Work.
45 B. The GC shall have responsibility for:
46 1. Ensuring that all contractors required to conduct a D&T session have successfully completed all of the
47 following:
48 a. Turned in all required documentation for review and documentation has been approved/accepted
49 prior to scheduling D&T sessions.
50 b. Other required documentation as needed is available and ready for use during the D&T session.
51 c. All systems have been started, tested, and running as per appropriate specification and/or
52 manufacturers recommendations prior to scheduling D&T sessions.
53 d. All contractors are sufficiently prepared for their D&T session
54 e. Documents the D&T session including date, time, contractor and company name, attendees and
55 other information regarding the session
56 2. Organizing the coordination and scheduling of all D&T sessions between all contractors and the
57 appropriate representatives of the Owner. These representatives may include any of the following
58 depending on the Work of the Contract:

- 1 a. Owner – end users
- 2 b. Facility Maintenance personnel
- 3 i. Facility general operation procedures including custodial services
- 4 ii. Electrical
- 5 iii. Mechanical
- 6 iv. Plumbing
- 7 v. Site
- 8 c. Information Technology (IT) Department
- 9 d. Traffic Engineering – Radio Shop
- 10 e. Architects, Engineers and Facility Management staff as project completion overview
- 11

12 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

13

14 **PART 3 - EXECUTION**

15

16 **3.1. GENERAL REQUIREMENTS**

- 17 A. The GC shall develop a specific D&T plan to be scheduled and conducted as described below but no sooner than
- 18 the meeting discussed in 3.2.A.2 below.
- 19 C. The GC shall not schedule D&T sessions to preclude required personnel from attending multiple sessions.
- 20

21 **3.2. COORDINATING AND SCHEDULING THE TRAINING**

- 22 A. The GC, PA/PE, CxA and CPM, shall review all Training and Demonstration requirements during two (2) special
- 23 meetings.
- 24 1. The first meeting shall be held at the 50% Contract Total Payment. During this meeting the following
- 25 shall be discussed:
- 26 a. Preliminary schedule of training dates to be completed prior to beginning construction closeout.
- 27 b. List of documentation and items that need to be completed and available before and during the
- 28 training session.
- 29 c. Who (Owner, Maintenance, etc) will be attending what training session(s).
- 30 2. The second meeting shall be held at the 80% Contract Total Payment. This meeting shall review due outs
- 31 that have not yet been completed for the 90% Contract Total Payment and the requirements necessary
- 32 for Construction Closeout. All Demonstration and Training sessions shall be completed prior to receiving
- 33 the 90% progress payment and beginning Construction Closeout Procedures (see Specification 01 77 00).
- 34 a. This does not include any requirement associated with off season equipment preparation and/or
- 35 demonstration and Training Sessions.
- 36 B. All of the Construction Work shall be operationally ready prior to conducting training as follows:
- 37 1. All contractors shall have their As-Built Drawing Records available for reviewing locations of system
- 38 components during training.
- 39 2. All final and approved Operations and Maintenance Data shall be completed no less than two (2) full
- 40 weeks prior to the scheduled training.
- 41 3. All systems shall have been started, functionally tested, balanced, and fully operational, and all piping
- 42 and equipment labeling complete at least two (2) days prior to the scheduled training.
- 43 a. Seasonal equipment shall not be trained out of season. Contractors having seasonal equipment
- 44 shall work with the GC and CPM for coordinating additional training sessions as appropriate for
- 45 seasonal equipment.
- 46 C. Correction list items that prevent a piece of equipment or system from being fully operational for training shall
- 47 be corrected prior to conducting the training.
- 48

49 **3.3. TRAINING OBJECTIVES**

- 50 A. For each piece of equipment or system installed train on the following objectives/topics as applicable:
- 51 1. System design, concept, and capabilities
- 52 2. Review of related contractor as-built drawings
- 53 3. Facility walkthrough to identify key components of the system
- 54 4. System operation and programming including weekly, monthly, annual test procedures
- 55 5. System maintenance requirements
- 56 6. System troubleshooting procedures
- 57 7. Testing, inspection, and reporting requirements associated with any regulatory requirements
- 58 8. Identification of any correction list items still outstanding

- 1 9. Review of system documentation including the following:
- 2 a. Operation and maintenance data
- 3 b. Warranties
- 4 c. Valve charts, tags, and pipe identification markers
- 5 B. For each piece of specialty equipment train on the following objectives/topics as applicable:
- 6 1. Manufacturers operations instructions
- 7 2. Manufacturers use and care instructions
- 8 3. Manufacturers maintenance and troubleshooting instructions
- 9 4. System operation and programming including weekly, monthly, annual test procedures
- 10 5. Identification of any correction list items still outstanding
- 11 6. Review of system documentation including the following:
- 12 a. Operation and maintenance data
- 13 b. Warranties
- 14 C. End User Orientation
- 15 1. Facility walkthrough
- 16 2. Security and emergency features
- 17 3. General facility operation procedures
- 18 D. Facility General Use and Custodial Services – if requested
- 19 1. Facility walkthrough
- 20 2. Security and emergency features
- 21 3. General facility operation procedures
- 22 4. Care and maintenance of specialty items, finishes, etc as requested
- 23 5. Attic stock inventory and material designations
- 24

25 **3.4. DEMONSTRATION AND TRAINING PROGRAM PREPARATION**

- 26 A. Each contractor having a responsibility for providing D&T sessions shall meet with the GC, CPM, and other City
- 27 Staff as needed to review the extent of the Training Objectives in section 3.3 above needed for each piece of
- 28 equipment, system, finish, etc. This meeting shall occur no less than four (4) weeks prior to the anticipated
- 29 training session.
- 30 B. The contractor shall use the information from item 3.4.A above to prepare a formal training program for each
- 31 piece of equipment or system based on the Training Objectives in 3.3 above.
- 32 1. The formal training program shall include the following information:
- 33 a. Session title
- 34 b. List of systems, equipment, use, care, etc to be covered during the session
- 35 c. Provide the following for each systems, equipment, use, care, etc to be covered during the session
- 36 i. Name and affiliation of each instructor to be used. As needed and discretion of the Owner
- 37 the GC to require attendance by the installing technician, installing Contractor and the
- 38 appropriate trade or manufacturer’s representative.
- 39 ii. Qualifications of each instructor to be used. Practical building operation expertise as well
- 40 as in-depth knowledge of all modes of operation of the specific piece of equipment as
- 41 installed in this project is required by the training personnel. If Owner determines training
- 42 was not adequate, the training shall be repeated until acceptable to Owner.
- 43 iii. A checklist of all documentation and system/equipment requirements necessary to
- 44 complete a successful training session and the current status of each
- 45 iv. Any additional documents, training aids, video or other items to be used to complete the
- 46 training
- 47 v. Any special requirements or needs associated with item iv above to complete the training
- 48 d. The intended audience for the training
- 49 e. The approximate duration of each objective or topic to be covered
- 50 2. Submit the completed training program to the GC for review and approval by the PA/PE and CPM.
- 51 C. The PA/PE and CPM shall work with staff as necessary to ensure all points of anticipated training needs have
- 52 been met. The PA/PE and CPM will approve the program as submitted or recommend changes for re-submittal
- 53 as necessary.
- 54

55 **3.5. CONDUCTING A DEMONSTRATION AND TRAINING SESSION**

- 56 A. All contractors shall conduct their required D&T Sessions as follows:
- 57 1. Begin with a classroom session
- 58 a. Provide a sign in sheet indicating all training to be conducted, instructors, etc.

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- b. Provide an overview of the training to be conducted including the approximate schedule.
 - 2. Conduct a general walk-through of the site.
 - a. Point out locations of various equipment, valves, charts, and other related items.
 - b. Use the Division or Trade As-Built record drawings to indicate locations of hidden or buried items.
 - 3. Provide a demonstration of general equipment/system operation including using the O&M manual.
 - a. Startup and shutdown procedures.
 - b. Normal operational levels as depicted by any gauges, software, etc.
 - c. Indicate warning devices, signs etc. and demonstrate emergency shut-down procedures.
 - 4. Provide a demonstration of all owner level maintenance using the O&M manual.
 - a. Indicate frequency of maintenance.
 - b. Provide and review all spare parts, special tools, and special materials.
 - 5. Provide and review all spare parts, special tools, special materials, or attic stock as applicable.
 - 6. While conducting D&T sessions:
 - a. Allow hands on training whenever practical.
 - b. Answer questions promptly
 - c. Repeat demonstrations and procedures as necessary.
 - B. Within two (2) working days of completing the D&T session the contractor responsible for the session shall turn-in any documentation generated including the sign in roster to the GC.
 - C. The GC shall turn over all training documentation to the PA/PE and CPM upon completion of D&T sessions.
 - D. Re-schedule any training that has been determined to be inadequate or inappropriate for any reason including but not limited to any of the following;
 - 1. Unqualified instructor
 - 2. System installation incomplete or untested to the specifications
 - 3. Equipment failure during demonstration
 - 4. Un-expected cancellation

3.6. CLOSEOUT PROCEDURE

- A. Prior to receiving the 90% Progress payment the GC shall:
 - 1. Verify with the PA/PE and CPM that each Demonstration and Training Session was conducted properly and according to the submitted plan.
 - 2. Any required "Off Season" equipment testing, balancing, and Demonstration and Training Sessions have been tentatively scheduled with the GC, necessary sub-contractors, instructors and Owner/Owner Representatives as necessary.

END OF SECTION

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27	PART 1 – GENERAL		
28			
29	1.1 RELATED DOCUMENTS		
30	A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other		
31	Division 01 Specification Sections, apply to this Section.		
32	B. Comply with Wisconsin Commercial Building Codes/International Existing Building Code (IBC).		
33	C. Comply with Americans with Disabilities Architectural Guidelines, and ICC/ANSI A117.1-Latest Edition.		
34	D. Comply with USGBC LEED prerequisites and credits shown in the attached checklist for Project to obtain		
35	certification based on USGBC’s LEEDv4.0 BD&C: New Construction and Major Renovations Process.		
36			
37	1.2 SUMMARY		
38	A. Section includes:		
39	B. Project registration and review fees associated with GBCI and leedonline.com are paid by the City.		
40	C. Section includes general requirements and procedures for compliance with USGBC’s LEED prerequisites and credits		
41	needed for Project to obtain LEED Silver certification based on USGBC’s "LEED Version 4/4.1 for Building Design and		
42	Construction" (hereafter, LEED v4 BD+C).		
43	1. Specific requirements for LEED are also included in other Sections.		
44	2. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and		
45	may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain		
46	LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and		
47	comparable product requests.		
48	3. A copy of LEED Project checklist is attached at end of this Section for information only.		
49	a. Some LEED prerequisites and credits needed to obtain indicated LEED certification depend on		
50	Architect’s design and other aspects of Project that are not part of the Work of the Contract.		
51	D. A significant portion of the credits required for certification are the responsibility of the A/E and Owner (design		
52	credits). These credits are not explicitly outlined in this specification section, however many aspects of the		
53	construction documents reflect intent to document and achieve the design credits. This section documents		
54	requirements of the contractor to meet the requirements for documenting the construction credits.		
55	E. Related Sections: Divisions 01 through 32 Sections for LEED requirements specific to the work of each of these		
56	Sections. Requirements may or may not include reference to LEED.		

- 1
2 1.3 DEFINITIONS
3 A. ANSI/BIFMA e3 Furniture Sustainability Standard: Standard addressing environmental and social impacts
4 throughout the furniture supply chain.
5 B. Albedo (a.k.a. solar reflectance): The ratio of the reflected electromagnetic energy to the incoming electromagnetic
6 energy.
7 C. Bio-Based Materials: Products containing some percentage of biologically renewable resource.
8 D. BUG Rating: Classification system for luminaires defined in terms of backlight (B), uplight (U), and glare (G).
9 E. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was
10 obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001. Certificates
11 shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
12 F. Cradle-to-Gate Assessment: Analysis of a product's partial life-cycle from extraction (cradle) to gate (factory
13 completion prior to distribution).
14 G. Emissivity (a.k.a. infrared emittance): A parameter between 0 and 1 that indicates the ability of a material to shed
15 infrared radiation.
16 H. Declare: A product transparency disclosure that identifies material source, composition, and end-of-life procedures.
17 I. Environmental Product Declaration (EPD): A transparency reporting tool communicating what a product is made of
18 and the environmental impact.
19 J. Extended Producer Responsibility: A waste management strategy promoting integration of life-cycle costs
20 associated with goods into the market price of products. Typically, this involves a take-back or recycling program
21 run by manufacturer at the end of the product's lifespan.
22 K. Facts: Standard evaluating sustainability of furniture products over the product life cycle.
23 L. Health Product Declaration (HPD): Disclosure of products contents and associated health information.
24 M. Hydrofluorocarbons (HFCs): Refrigerants used in building equipment that do not deplete the stratospheric ozone
25 layer.
26 N. LEED: USGBC's "LEED Version 4/4.1 for Building Design and Construction." Definitions that are part of this document
27 apply to this Section.
28 O. Life-Cycle Assessment: Evaluation of environmental impacts of a product from cradle to gate, defined by ISO 14040
29 and ISO 14044.
30 P. Life-Cycle Inventory: Database that defines environmental input and output for each step in a material or
31 assembly's life cycle.
32 Q. Living Product Challenge: A product framework for manufacturers examining place, water, energy, health,
33 materials, and equity in production of materials.
34 R. Locally-Manufactured: Refers to the final assembly of components into the building product that is furnished and
35 installed by the trades people. For example, if the hardware comes from Seoul, South Korea, the lumber from
36 Vancouver, British Columbia, and the joist is assembled in Kent Washington, then the location of the final assembly
37 is Kent, Washington.
38 S. Manufacturer Inventory: A published, complete content inventory for products.
39 T. Product Lens: Transparency disclosure highlighting hazard information.
40 U. REACH Optimization: International standard outlining hazardous substances of high concern to be avoided in
41 material composition.
42 V. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled
43 fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
44 1. "Postconsumer" material is defined as waste material generated by households or by commercial,
45 industrial, and institutional facilities in their role as end users of the product, which can no longer be used
46 for its intended purpose.
47 2. "Preconsumer" material is defined as material diverted from the waste stream during the manufacturing
48 process. Reutilization of materials (such as rework, regrind, or scrap generated in a process and capable of
49 being reclaimed within the same process that generated it) is excluded.
50 W. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within
51 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and
52 manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
53 X. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project site.
54 Manufacturing refers to the final assembly of components into the building product that is installed at Project site.
55 Y. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials
56 that are extracted, harvested, or recovered within a radius of 500 miles from Project site.
57 Z. Solar Reflectance Index (SRI): The measure of a constructed surface's ability to stay cool in the sun by reflecting
58 solar radiation and emitting thermal radiation. SRI values range from zero (solid black surface) to 100 (solid white

- 1 surface). SRI value of a material is calculated according to ASTM E1980 and based on the aged tested values of solar
2 reflectance and thermal emittance.
- 3 AA. Type A Finishes: Material and finishes with potential for short-term levels of off gassing from chemicals inherent in
4 their manufacturing process, or which are applied in form requiring vehicles or carriers for spreading which release
5 high level of particulate matter in process of installation and/or curing. Including, but not limited to:
- 6 1. Composite wood products, specifically including particleboard from which millwork, wood paneling, doors,
7 or furniture may be fabricated.
- 8 2. Adhesives, sealants, and glazing compounds, specifically those with petrochemical vehicles or carriers.
- 9 3. Wood preservatives, finishes, and paint.
- 10 4. Control and/or expansion joint-fillers.
- 11 5. Hard finishes requiring adhesive installation.
- 12 6. Gypsum board and associated finish processes.
- 13 BB. Type B Finishes: Fuzzy material and finishes which are woven, fibrous, or porous in nature and tend to adsorb
14 chemicals off-gassed by Type A finishes or may be adversely affected by particulates. These materials become
15 "sink" for deleterious substances which may be released much later, or collectors of contaminants that may
16 promote subsequent bacterial growth. Including, but not limited to:
- 17 1. Carpeting and padding.
- 18 2. Fabric wallcovering.
- 19 3. Insulation exposed to air stream.
- 20 4. Acoustic ceiling materials.
- 21 5. Fabric covered acoustic wall panels.
- 22 6. Upholstered furnishings.
- 23 7. Materials that can be categorized as both Type A and TypeB.
- 24 CC. Ventilation: The process of supplying and removing air to and from interior spaces by natural or mechanical means.
- 25 DD. Volatile organic compounds (VOCs): Chemical compounds based on carbon and hydrogen structures that are
26 vaporized at room temperatures. VOCs are one type of indoor aircontaminant.
- 27 EE. Waste Materials: Large and small pieces of materials indicated which are excess to contract requirements and
28 generally include materials salvaged from existing construction and items of trimmings, cuttings, and damaged
29 goods resulting from new installations which cannot be effectively used in Work.
- 30 FF. Vertical Illuminance: Illuminance levels calculated at a point on a vertical service or plane.
- 31 GG. WaterSense Label: The WaterSense label from the EPA specifies water efficiency and performance.
- 32 HH. Whole-Building Life-Cycle Assessment: The Life Cycle Assessment (LCA) is a methodology that evaluates the carbon
33 and other environmental impacts of building materials over the projected lifespan of the building.
- 34
- 35 1.4 LEED MEETINGS
- 36 A. Pre-construction Conference: Conduct conference at **Project site**. Review LEED requirements and action plans for
37 compliance with requirements.
- 38
- 39 1.5 ADMINISTRATIVE REQUIREMENTS
- 40 A. Respond to questions and requests from Architect about USGBC's LEED prerequisites and credits that are
41 Contractor's responsibility, that depend on product selection or product qualities, or that depend on Contractor's
42 procedures until USGBC has made its determination on Project's LEED certification application
- 43 B. Submit documentation to USGBC and respond to questions and requests from USGBC about its LEED prerequisites
44 and credits that are Contractor's responsibility, that depend on product selection or product qualities, or that
45 depend on Contractor's procedures, until USGBC has made its determination on Project's LEED certification
46 application.
- 47 1. Document correspondence with USGBC as informational submittals.
- 48
- 49 1.6 ACTION SUBMITTALS
- 50 A. General: Submit sustainable design submittals required by other Sections.
- 51 B. Sustainable design submittals are in addition to other submittals.
- 52 1. If submitted item is identical to that proposed to comply with other requirements, include additional copy
53 with other submittal as a record of compliance with indicated LEED requirements instead of separate
54 sustainable design submittal. Mark additional copy "Sustainable design submittal."
- 55 C. Sustainable Design Documentation Submittals:
- 56 1. Summary Sheet: A summary, on General Contractors letterhead, of all LEED information requested in
57 specifications shall include:
- 58 a. METRO TRANSIT HANSON RD BUS FACILITY REMODEL.

- 1 b. LEED Submittal List: A list of all materials being submitted. For products composed of multiple
- 2 materials the submittal shall include a list of all materials composing the product.
- 3 c. For Products in Divisions 2 - 10, include the following information:
- 4 1) Material costs, for each material on the LEED submittal list, excluding labor costs, delivery
- 5 cost, cost of installation, as well as profit and overhead.
- 6 2) The preconsumer and post-consumer recycled content of each material on the LEED
- 7 submittal list.
- 8 3) List of all material manufacturing locations.
- 9 4) Provide distance between manufacturing and construction site.
- 10 d. All other LEED information required in specification.
- 11 2. Manufacturer's literature with information highlighted that confirm the figures used in the summary report.
- 12 a. If a range is used in the manufacturer's literature, the summary report shall use the lowest number
- 13 in the range.
- 14 b. For VOC Submissions: Submit MSDS sheets or manufacturer's literature with VOC figure highlighted.
- 15 3. Documentation for luminaires indicating BUG ratings, lumens emitted, and vertical illuminance values.
- 16 4. Documentation for compliant paving materials indicating the SRI, SR, and permeability.
- 17 5. Documentation for compliant roofing materials indicating the SRI.
- 18 6. Product Data and certification for WaterSense-labeled water fixtures.
- 19 7. Product Data for plumbing fixtures indicating flush or flow rate.
- 20 8. Plumbing submittal packages.
- 21 9. Mechanical submittal packages.
- 22 10. Environmental Product Declarations (EPDs) complying with LEED requirements.
- 23 11. Documentation for products that comply with LEED requirements for multi-attribute optimization.
- 24 a. Include documentation for regional materials, indicating location and distance from Project of
- 25 material manufacturer and point of extraction, harvest, or recovery for each raw material and costs
- 26 of regional materials.
- 27 b. Include documentation for any applicable third-party certifications.
- 28 12. Sustainability reports for products that comply with LEED requirements for raw material and source
- 29 extraction reporting.
- 30 13. Documentation for products that comply with LEED requirements for leadership extraction practices.
- 31 Include the following:
- 32 a. Product Data and certification letter from product manufacturers, indicating participation in an
- 33 extended producer responsibility program and statement of costs.
- 34 b. Product Data and certification for bio-based materials, indicating that they comply with
- 35 requirements. Include statement of costs.
- 36 c. Product Data and chain-of-custody certificates for products containing certified wood. Include
- 37 invoices.
- 38 d. Receipts for salvaged and refurbished materials used for Project, indicating sources and costs.
- 39 e. Product Data and certification letter from product manufacturers, indicating percentages by weight
- 40 of postconsumer and preconsumer recycled content for products having recycled content. Include
- 41 statement of costs.
- 42 f. Documentation for regional materials, indicating location and distance from Project of material
- 43 manufacturer and point of extraction, harvest, or recovery for each raw material and costs of
- 44 regional materials.
- 45 14. Material ingredient reports for products that comply with LEED requirements for material ingredient
- 46 reporting.
- 47 15. Documentation for products that comply with LEED requirements for material ingredient optimization.
- 48 16. Documentation for products that comply with LEED requirements for product manufacturer supply chain
- 49 optimization.
- 50 a. Include documentation for regional materials, indicating location and distance from Project of
- 51 material manufacturer and point of extraction, harvest, or recovery for each raw material and costs
- 52 of regional materials.
- 53 17. Documentation complying with Section 017419 "Construction Waste Management and Disposal."
- 54 18. Product Data for adhesives and sealants used inside weatherproofing system, indicating VOC content and
- 55 laboratory test reports showing compliance with requirements for low-emitting materials.
- 56 19. Product Data for paints and coatings used inside weatherproofing system, indicating VOC content and
- 57 laboratory test reports showing compliance with requirements for low-emitting materials.
- 58 20. Laboratory test reports for flooring, indicating compliance with requirements for low-emitting materials.

- 1 21. Laboratory test reports for products containing composite wood or agrifiber products or wood glues,
2 indicating compliance with requirements for low-emitting materials.
- 3 22. Laboratory test reports for wall materials, indicating compliance with requirements for low-emitting
4 materials.
- 5 23. Laboratory test reports for ceilings, indicating compliance with requirements for low-emitting materials.
- 6 24. Laboratory test reports for insulation, indicating compliance with requirements for low-emitting materials.
- 7 25. Construction Indoor-Air-Quality (IAQ) Management:
8 a. Construction IAQ management plan.
9 b. Product Data for temporary filtration media.
10 c. Product Data for filtration media used during occupancy.
11 d. Construction Documentation: Six photographs at three different times during construction period,
12 along with brief description of SMACNA approach employed, documenting implementation of IAQ
13 management measures, including protection of ducts and on-site stored or installed absorptive
14 materials.
- 15 26. IAQ Assessment:
16 a. Signed statement describing the building air flush-out procedures, including dates when flush-out
17 was begun and completed and statement that filtration media was replaced after flush-out.
18 b. Product Data for filtration media used during flush-out and occupancy.
19 c. Report from testing and inspecting agency indicating results of IAQ testing and documentation that
20 show compliance with IAQ testing procedures and requirements.
- 21 D. Sustainable Design Action Plans: Provide preliminary submittals within **30** days of date established for **the Notice to**
22 **Proceed**, indicating how the following requirements will be met:
23 1. Example spreadsheets for each construction credit identified in this section.
24 2. Contact information for Contractor's LEED coordinators.
25 3. Brief description of how the following requirements will be met.
26 a. SS Prerequisite: Construction Activities Pollution Prevention complying with Section 31 25 00,
27 Erosion Control.
28 b. EA Prerequisite: Fundamental Commissioning and Verification complying with Section 01 91 13,
29 General Commissioning requirements.
30 c. EA Credit: Enhanced Commissioning.
31 d. MR Prerequisite: Construction and Demolition Waste Management Reporting
32 e. MR Credit: Building Product Disclosure – Environmental Product Disclosures
33 f. MR Credit: Building Product Disclosure – Source Materials
34 g. MR Credit: Building Product Disclosure – Material Ingredients
35 h. MR Credit: Construction and Demo Waste Management complying with Section 01 74 19
36 Construction Waste Management and Disposal. Include a sample spreadsheet showing how the
37 tipping information is going to be recorded to comply with LEED requirements.
38 i. IEQ Credit: Low-Emitting Materials
39 j. IEQ Credit: Construction IAQ Management Plan
40 k. IEQ Credit: Indoor Air Quality Assessment
41 l. List of proposed products with EPDs.
42 m. List of proposed products complying with requirements for multi-attribute optimization.
43 n. List of proposed products complying with requirements for raw material and source extraction
44 reporting.
45 o. List of proposed products complying with requirements for leadership extraction practices.
46 p. List of proposed products complying with requirements for material ingredient reporting.
47 q. List of proposed products complying with requirements for material ingredient optimization.
48 r. List of proposed products complying with requirements for product manufacturer supply chain
49 optimization.
- 50 4. After approval of the Preliminary Action Plan the Contractor shall update the plan monthly with LEED
51 information collected to date and be submitted as part of a monthly progress report.
- 52 E. Sustainable Design Progress Reports: Concurrent with each monthly progress report, submit reports comparing
53 actual construction and purchasing activities with sustainable design action plans.
- 54 F. LEED Documentation Online Submittals: The Contractor shall be responsible for completing the following LEED
55 submissions using the LEED online tool for credit submission to USGBC. The LEED Project Administrator will
56 determine if the information prepared by the Contractor is satisfactory for USGBC submission.
57 1. SS Prerequisite: Construction Activities Pollution Prevention
58 2. EA Prerequisite: Fundamental Commissioning and Verification.

- 1 3. EA Credit: Enhanced Commissioning.
- 2 4. MR Prerequisite: Construction and Demolition Waste Management Reporting
- 3 5. MR Credit: Building Product Disclosure – Environmental Product Disclosures
- 4 6. MR Credit: Building Product Disclosure – Source Materials
- 5 7. MR Credit: Building Product Disclosure – Material Ingredients
- 6 8. MR Credit: Construction and Demo Waste Management
- 7 9. IEQ Credit: Low-Emitting Materials
- 8
- 9 1.7 INFORMATIONAL SUBMITTALS
- 10 A. Qualification Data: For Sustainability Consultant.
- 11 B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude
- 12 labor, overhead, and profit. Include breakout of costs for the following categories of items:
- 13 1. Plumbing.
- 14 2. Mechanical.
- 15 3. Electrical.
- 16 4. Specialty items such as equipment.
- 17
- 18 1.8 QUALITY ASSURANCE
- 19 A. Sustainability Consultant: Engage an experienced LEED Accredited Professional to coordinate LEED requirements.
- 20 Sustainability Consultant may also serve as waste management coordinator.
- 21 B. LEED Version v4 BD+C: Lead Contractor to have a copy of the LEED Reference Manual available on site.
- 22 C. Completion of LEED Documentation: Contractor is required to provide information and back up as needed to
- 23 complete LEED Design and Construction submittals. Contractor must be available and able to react to USGBC
- 24 review comments in a timely fashion for any credits that require additional follow up from formal reviews.
- 25 D. Multiple Contractors: Each prime contractor is responsible for adhering to the Indoor Environmental Quality credits
- 26 for adhesives, sealants, paints and coatings used on the project. Each contractor is responsible for providing
- 27 required LEED documentation.
- 28
- 29 1.9 CONTRACTOR RESPONSIBILITIES
- 30 A. This project has been registered with USGBC. The Contractor shall provide all necessary documentation for LEED
- 31 Version v4/4.1 BD+C certification in accordance with the specifications. Format and content of all construction
- 32 documentation must be in accordance with the LEED Reference Guide requirements for supporting data required in
- 33 event of USGBC audit of the particular credit. Contractor is required to coordinate all requirements to assure
- 34 assembled data is acceptable to USGBC and respond to USGBC requests for additional construction data in the
- 35 course of preparing the project for certification.
- 36
- 37 PART 2 - PRODUCTS
- 38
- 39
- 40 2.1 MATERIALS
- 41 A. Provide products and procedures necessary to obtain LEED credits indicated as Contractor's responsibility. Although
- 42 other Sections may specify some requirements that contribute to these LEED credits, Contractor shall provide
- 43 additional materials and procedures necessary to obtain LEED credits indicated.
- 44 B. Recycled Content: Building materials have recycled content such that postconsumer recycled content plus one-half
- 45 of preconsumer recycled content for Project constitutes a minimum of 20 percent of cost of materials used for
- 46 Project.
- 47 1. Cost of postconsumer recycled content plus one-half of preconsumer recycled content of an item to be
- 48 determined by dividing weight of postconsumer recycled content plus one-half of preconsumer recycled
- 49 content in the item by total weight of the item and multiplying by cost of the item.
- 50 2. Do not include plumbing, mechanical and electrical components, and specialty items, such as elevators and
- 51 equipment, in the calculation.
- 52 2.2 BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION
- 53 A. MR Credit Product Disclosure and Optimization - Environmental Product Declarations (EPD)
- 54 1. At least 10 different products from at least three different manufacturers shall have EPDs that comply with
- 55 LEED requirements.
- 56 a. Product-specific Type III EPDs are valued as one and one-half of a product.
- 57 2. Exemplary Performance:

- 1 a. At least 20 different products from at least five different manufacturers shall have EPDs that comply
- 2 with LEED requirements.
- 3 B. MR Credit Product Disclosure and Optimization – Sourcing of Raw Materials
- 4 1. At least 15 percent, by cost, and from at least three different manufacturers of permanently installed
- 5 products for Project comply with LEED requirements for sourcing of raw materials.
- 6 C. MR Credit Product Disclosure and Optimization – Material Ingredients
- 7 1. At least 10 different products from at least three different manufacturers shall comply with LEED
- 8 requirements for material ingredient reporting.
- 9 2. At least 5 permanently installed products sourced from at least three different manufactures.
- 10 3. Exemplary Performance:
- 11 a. At least 20 different products from at least five different manufacturers shall comply with LEED
- 12 requirements for material ingredient reporting.
- 13 2.3 LOW-EMITTING MATERIALS
- 14 A. Paints and Coatings: For field applications that are inside the weatherproofing system, paints and coatings shall
- 15 comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
- 16 1. Flat Paints and Coatings: 50 g/L.
- 17 2. Nonflat Paints and Coatings: 50 g/L.
- 18 3. Dry-Fog Coatings: 150 g/L.
- 19 4. Primers, Sealers, and Undercoaters: 100 g/L.
- 20 5. Rust-Preventive Coatings: 100 g/L.
- 21 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
- 22 7. Pretreatment Wash Primers: 420 g/L.
- 23 8. Clear Wood Finishes, Varnishes: 275 g/L.
- 24 9. Clear Wood Finishes, Lacquers: 275 g/L.
- 25 10. Floor Coatings: 50 g/L.
- 26 11. Shellacs, Clear: 730 g/L.
- 27 12. Shellacs, Pigmented: 550 g/L.
- 28 13. Stains: 100 g/L.
- 29 B. Paints and Coatings: For field applications that are inside the weatherproofing system, 90 percent of paints and
- 30 coatings shall comply with requirements of California Department of Public Health's "Standard Method for the
- 31 Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental
- 32 Chambers."
- 33 C. Adhesives and Sealants: For field applications that are inside the weatherproofing system, adhesives and sealants
- 34 shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
- 35 1. Wood Glues: 30 g/L.
- 36 2. Metal-to-Metal Adhesives: 30 g/L.
- 37 3. Adhesives for Porous Materials (except Wood): 50 g/L.
- 38 4. Subfloor Adhesives: 50 g/L.
- 39 5. Plastic Foam Adhesives: 50 g/L.
- 40 6. Carpet Adhesives: 50 g/L.
- 41 7. Carpet Pad Adhesives: 50 g/L.
- 42 8. VCT and Asphalt Tile Adhesives: 50 g/L.
- 43 9. Cove Base Adhesives: 50 g/L.
- 44 10. Gypsum Board and Panel Adhesives: 50 g/L.
- 45 11. Rubber Floor Adhesives: 60 g/L.
- 46 12. Ceramic Tile Adhesives: 65 g/L.
- 47 13. Multipurpose Construction Adhesives: 70 g/L.
- 48 14. Fiberglass Adhesives: 80 g/L.
- 49 15. Contact Adhesives: 80 g/L.
- 50 16. Structural Glazing Adhesives: 100 g/L.
- 51 17. Wood Flooring Adhesives: 100 g/L.
- 52 18. Structural Wood Member Adhesives: 140 g/L.
- 53 19. Single-Ply Roof Membrane Adhesives: 250 g/L.
- 54 20. Special-Purpose Contact Adhesives (That Are Used to Bond Melamine-Covered Board, Metal, Unsupported
- 55 Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
- 56 21. Top and Trim Adhesives: 250 g/L.
- 57 22. Plastic Cement Welding Compounds: 250 g/L.
- 58 23. ABS Welding Compounds: 325 g/L.

- 1 24. CPVC Welding Compounds: 490 g/L.
- 2 25. PVC Welding Compounds: 510 g/L.
- 3 26. Adhesive Primer for Plastic: 550 g/L.
- 4 27. Sheet-Applied Rubber Lining Adhesives: 850 g/L.
- 5 28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
- 6 29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
- 7 30. Special-Purpose Aerosol Adhesives (All Types): 70 percent by weight.
- 8 31. Other Adhesives: 250 g/L.
- 9 32. Architectural Sealants: 250 g/L.
- 10 33. Nonmembrane Roof Sealants: 300 g/L.
- 11 34. Single-Ply Roof Membrane Sealants: 450 g/L.
- 12 35. Other Sealants: 420 g/L.
- 13 36. Sealant Primers for Nonporous Substrates: 250 g/L.
- 14 37. Sealant Primers for Porous Substrates: 775 g/L.
- 15 38. Modified Bituminous Sealant Primers: 500 g/L.
- 16 39. Other Sealant Primers: 750 g/L.
- 17 D. Adhesives and Sealants: For field applications that are inside the weatherproofing system, 90 percent of adhesives
18 and sealants shall comply with requirements of California Department of Public Health's "Standard Method for the
19 Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental
20 Chambers."
- 21 E. Flooring: Shall comply with requirements of California Department of Public Health's "Standard Method for the
22 Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental
23 Chambers."
- 24 F. Composite Wood, Agrifiber Products, and Adhesives: Shall be made using ultra-low-emitting formaldehyde resins as
25 defined in California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions
26 from Composite Wood Products" or shall be made with no added formaldehyde.
- 27 G. Ceilings, Walls, and Thermal Insulation: Shall comply with requirements of California Department of Public Health's
28 "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using
29 Environmental Chambers."

30
31 PART 3 - EXECUTION

32
33
34 3.1 NONSMOKING BUILDING

- 35 A. Smoking is not permitted within the building or within 25 ft. of entrances, operable windows, or outdoor-air
36 intakes.

37
38 3.2 CONSTRUCTION ACTIVITIES POLLUTION PREVENTION

- 39 A. SS Prerequisite - Construction Activities Pollution Prevention:
 - 40 1. Follow LEED instructions in LEED NCv4.0 Reference Guide and complying with Section 31 25 00, Erosion
41 Control. Comply with EPA Construction General Permit (CGP) standard 2012.
 - 42 2. Contractor is responsible for completing the LEED online credit template and attaching the following
43 information to the template:
 - 44 a. Provide record of compliance with Erosion and Sediment Control Plan:
 - 45 1) Monthly photographs of barriers and containment.
 - 46 2) Monthly photographs of dust control measures
 - 47 3) Records of inspections by agency in charge of overseeing compliance.
 - 48 4) Include dust control measures
 - 49 b. Several early, a middle and several near end prevention plan checks and reports will be required as
50 an upload to LEED Online – assume 6 checks and reports over the duration of the project.
 - 51 3. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
52 for GBCI submission.

53
54 3.3 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

- 55 A. MR Prerequisite and Credit: Comply with Division 1 Section "Construction Waste Management and Disposal".
 - 56 1. Contractor is required to create a Construction Waste Management Plan that includes:

- 1 a. Establishing waste diversion goals for the project by identifying at least five material streams
2 targeted for diversion. Approximate a percentage of the overall project waste that these materials
3 represent.
- 4 b. Specifying whether materials will be separated or commingled and describe the diversion strategies
5 planned for the project. Describe where the material will be taken and how the recycling facility will
6 process the material.
- 7 c. A final report detailing all major waste streams generated, including disposal and diversion rates.
- 8 2. Contractor is required to meet the following minimum goal:
 - 9 a. Option 1 Path 2 – Divert 75% and four material streams, or
 - 10 1) A material stream can be a specific material category that is diverted in a specific way or a
11 mixture of several material categories that are diverted in a specific way.
 - 12 2) Best practice is that a material stream should constitute at least 5% (by weight or volume) of
13 total diverted materials.
 - 14 3) Examples of material streams include Plastic, Carpet, Paper/Cardboard, Wood, metal,
15 Sheetrock, Brick, Concrete, Shingles, deconstructed materials, commingled waste, reuse of
16 deconstructed materials onsite, source separation where each material is sent to a specific
17 facility or suppliers take-back of materials.
 - 18 b. Option 2 – Do not generate more than 2.5 pounds of construction waste per square foot of the
19 buildings floor area (2 points).
- 20 3. Contractor is responsible for completing the LEED online credit template. Attached documentation in
21 support of the credit shall include:
 - 22 a. Monthly photographs of waste recycling sorting area including:
 - 23 1) Debris control fencing.
 - 24 2) Signage clearly identifying the containers content.
 - 25 b. Spreadsheet containing the following information:
 - 26 1) Diverted materials description.
 - 27 2) Diverted materials/waste hauler name.
 - 28 3) Date of each haul
 - 29 4) Quantity of material in each haul.
 - 30 c. Copies of recycling vender and waste hauler tipping receipts.
- 31 4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
32 for GBCI submission.
- 33 3.4 Building product disclosure and optimization
 - 34 A. MR Credits Building Product Disclosure Optimization – EPDs, Sourcing and Ingredients
 - 35 1. Environmental Product Declarations – comply with one of the following Options:
 - 36 a. Option 1: Environmental Product Declarations (1 point)
 - 37 b. Option 2: Multi-Attribute Optimization (1 point) including products that demonstrate impact
38 reduction below industry average in global warming potential, ozone depletion, acidification of land
39 and water, eutrophication, tropospheric ozone, or other USGBC approved program.
 - 40 2. Sourcing of Raw Materials – comply with one of the following Options:
 - 41 a. Option 1: Raw Material Source and Extraction Reporting (1 point)
 - 42 b. Option 2: Leadership Extraction Practices (1 point) including producer responsibility, bio-based
43 materials, wood products, material reuse, recycle content or other approved USGBC program
 - 44 3. Material Ingredients - comply with two of the following Options:
 - 45 a. Option 1: Material Ingredient Reporting (1 point)
 - 46 b. Option 2: Material Ingredient Optimization (1 point) including GreenScreen v1.2 Benchmark, Cradle
47 to Cradle Certification, REACH Optimization or other approved USGBC program.
 - 48 c. Option 3: Product Manufacturer Supply Chain Optimization (1 point) including products from
49 manufacturers with validated and robust safety, health, hazard and risk programs that document
50 99% by weight of the ingredients used to make the product.
 - 51 4. Contractor to complete and submit the MR building product disclosure and optimization calculator,
52 available with the project in LEED Online
 - 53 5. Contractor to submit supporting documentation including EPD and LCA reports, corporate sustainability
54 reports, product declarations, labels, REACH, GreenScreen Benchmark, LT scores or other compliance
55 summary documents. LEED project administrator and/or GBCI may require revisions and additions to this
56 documentation and Contractor should plan accordingly.
 - 57 6. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
58 for GBCI submission.

- 1 3.5 CONSTRUCTION INDOOR-AIR-QUALITY (IAQ) MANAGEMENT
- 2 A. IEQ Credit Construction IAQ Management Plan: Intent is to promote the well-being of construction workers and
- 3 building occupants by minimizing indoor air quality problems associated with construction and renovation.
- 4 Contractor to include at a minimum the following elements into the plan:
- 5 1. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
- 6 2. Prohibit the use of tobacco products inside the building and within 25 feet of the building entrances
- 7 during construction.
- 8 3. Protect absorptive materials stored on-site and installed from moisture damage.
- 9 4. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction
- 10 period as specified in Division 1 Section "Temporary Facilities and Controls", install filter media having a
- 11 MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during
- 12 construction.
- 13 5. Replace all air filters immediately prior to occupancy.
- 14 B. Provide record of compliance with Indoor Air Quality Management Plan:
- 15 a. Monthly photographs of equipment and ductwork protection.
- 16 b. Monthly photographs of filters used to protect air distribution and equipment.
- 17 c. Contractor's report documenting that MERV 8 filters were used to protect equipment during
- 18 construction and filters meeting final design requirements were installed prior to occupancy.
- 19
- 20 3.6 INDOOR-AIR-QUALITY (IAQ) ASSESSMENT
- 21 A. IEQ Credit – Indoor Air Quality Assessment: Intent is to establish better quality indoor air in the building after
- 22 construction and during occupancy.
- 23 B. Contractor is required to implement one of the following options:
- 24 1. Option 1, Path 1 (1 point): After construction ends, prior to occupancy and with all interior finishes and
- 25 furniture installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air
- 26 per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and no higher than 80
- 27 deg F and a relative humidity no higher than 60 percent.
- 28 2. Option 1, Path 2 (1 point): If occupancy is desired prior to flush-out completion, with furniture installed, the
- 29 space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area
- 30 to the space while maintaining an internal temperature of at least 60°F and no higher than 80°F and relative
- 31 humidity no higher than 60%. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm
- 32 per sq. ft. of outside air or the design minimum outside air rate determined in IEQ Prerequisite 1, whichever
- 33 is greater. During each day of the flush-out period, ventilation shall begin a minimum of three (3) hours
- 34 prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of
- 35 14000 cu. ft./sq. ft. of outside air has been delivered to the space.
- 36 3. Option 2 (2 points) - Air-Quality Testing: If the Contractor chooses to test for compliance with this credit
- 37 following is required, including contracting with an industrial hygienist to conduct testing:
- 38 a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using
- 39 testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air
- 40 Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and
- 41 Construction Reference Guide".
- 42 b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
- 43 1) Formaldehyde: 27 ppb.
- 44 2) Particulates (PM10): 50 micrograms/cu. m.
- 45 3) Particulates (PM2.5): 15 micrograms/cu. m.
- 46 4) Ozone: 0.075 ppm
- 47 5) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
- 48 6) Target chemicals listed in CDPH Standard Method v1.1, Table 4-1, except formaldehyde -see
- 49 *supplement at end of this specification for table*
- 50 7) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
- 51 c. For each sampling point where the maximum concentration limits are exceeded, conduct additional
- 52 flush-out with outside air and retest the specific parameter(s) exceeded to indicate the
- 53 requirements are achieved. Repeat procedure until all requirements have been met. When retesting
- 54 non-complying building areas, samples are to be taken from the same locations as the first test.
- 55 d. Air-sample testing shall be conducted as follows:
- 56 1) All measurements shall be conducted prior to occupancy but during normal occupied hours
- 57 and with building ventilation system starting at the normal daily start time and operated at

- 1 the minimum outside air flow rate for the occupied mode throughout the duration of the air
2 testing.
3 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors,
4 paint, carpet, acoustic tiles and non-fixed furnishings such as workstations and partitions.
5 3) Number of sampling locations will vary depending on the size of building and number of
6 ventilation systems. For each portion of building served by a separate ventilation system,
7 the number of sampling points shall not be less than one per 25,000 sq. ft. or for each
8 contiguous floor area, whichever is larger, and shall include areas with the least ventilation
9 and greatest presumed source strength.
10 4) Air samples shall be collected between 3 and 6 feet from the floor to represent the
11 breathing zone of occupants, and over a minimum four- hour period.
12 4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
13 for GBCI submission.

14 3.7 SUPPLEMENT

- 15 A. The supplement listed below, up to "End of Section," is a part of this Specification:
16 1. LEED BD&C v4.0/4.1 Project Checklist.
17 a. All credits listed for reference
18 b. Only **Bold, Italic** credits or prerequisites listed with a "C" are in the Scope of the Contractor
19 c. All identified construction Prerequisites are required to be achieved to complete the certification
20 process and are the responsibility of the Contractor. Care needs to be taken to ensure all
21 prerequisites are awarded to the project.
22 d. All identified construction Credits are required to be achieved and are the responsibility of the
23 Contractor. Given certain point totals and project specific circumstances as the project
24 progresses, with proper notice to the City's Project Manager, certain credits or credit point
25 thresholds can be added/eliminated from the project. Written notice and approval is required.
26 2. Target CREL VOCs, Table 4-1 for Indoor Air Quality Testing
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LEED v4/4.1 for BD+C: Warehouses and Distribution Centers

Project Checklist

Project Name: Madison Metro Satellite Bus Facility
 Date: 15-Sep-23

Y	?	N	R
1			D

Credit	Integrative Process	1
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6	3	7		Location and Transportation	16
Credit				LEED for Neighborhood Development Location	16
1			D	Sensitive Land Protection	1
1	1		D	v4.1 High Priority Site	2
3		2	D	Surrounding Density and Diverse Uses	5
1	1	3	D	v4.1 Access to Quality Transit	5
		1		Bicycle Facilities	1
	1			Reduced Parking Footprint	1
		1		Green Vehicles	1

3	2	5		Sustainable Sites	10
Y			C	Prereq Construction Activity Pollution Prevention	Required
1				Credit Site Assessment	1
	1	1	1	Credit Site Development - Protect or Restore Habitat	2
		1	1	Credit Open Space	1
1	1	1	1	Credit v4.1 Rainwater Management	3
		2	2	Credit Heat Island Reduction	2
1				Credit Light Pollution Reduction	1

3	2	6		Water Efficiency	11
Y			D	Prereq Outdoor Water Use Reduction	Required
Y			D	Prereq Indoor Water Use Reduction	Required
Y			D	Prereq Building-Level Water Metering	Required
2			D	Credit Outdoor Water Use Reduction	2
1	2	3	D	Credit Indoor Water Use Reduction	6
		2		Credit Cooling Tower Water Use	2
		1		Credit Water Metering	1

10	7	16		Energy and Atmosphere	33
Y			C	Prereq Fundamental Commissioning and Verification	Required
Y			D	Prereq Minimum Energy Performance	Required
Y			D	Prereq Building-Level Energy Metering	Required
Y			D	Prereq Fundamental Refrigerant Management	Required
3	3		C	Credit Enhanced Commissioning	6
5		13	D	Credit Optimize Energy Performance	18
		1		Credit Advanced Energy Metering	1
		2		Credit Demand Response	2
	3			Credit v4.1 Renewable Energy Production	3
1			D	Credit Enhanced Refrigerant Management	1
1	1		D	Credit Green Power and Carbon Offsets	2

11	2	0		Materials and Resources	13
Y			D	Prereq Storage and Collection of Recyclables	Required
Y			C	Prereq Construction and Demolition Waste Management Planning	Required
5			D	Credit v4.1 Building Life-Cycle Impact Reduction	5
1	1		C	Credit v4.1 Building Product Disclosure and Optimization - Environmental Product Declarations	2
1	1		C	Credit v4.1 Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
2			C	Credit v4.1 Building Product Disclosure and Optimization - Material Ingredients	2
2			C	Credit v4.1 Construction and Demolition Waste Management	2

10	4	2		Indoor Environmental Quality	16
Y			D	Prereq Minimum Indoor Air Quality Performance	Required
Y			D	Prereq Environmental Tobacco Smoke Control	Required
1	1		D	Credit Enhanced Indoor Air Quality Strategies	2
2	1		C	Credit Low-Emitting Materials	3
1			C	Credit Construction Indoor Air Quality Management Plan	1
1		1	C	Credit Indoor Air Quality Assessment	2
		1		Credit Thermal Comfort	1
2			D	Credit Interior Lighting	2
2	1		D	Credit Daylight	3
1			D	Credit Quality Views	1
1			C	Credit Acoustic Performance	1

4	0	0		Innovation	4
1			C	Credit Exemplary Performance - Environmental Product Declarations (EPD)	1
1			C	Credit Exemplary Performance - Material Ingredients	1
1			D	Credit Innovation - Blower Door Testing	1
1			D	Credit LEED Accredited Professional	1

2	0	0		Regional Priority	4
1			D	Credit Regional Priority: Green Vehicles	1
1			D	Credit Regional Priority: Sensitive land protection	1
				Credit Regional Priority: Specific Credit	1
				Credit Regional Priority: Specific Credit	1

50 **20** **36** **TOTALS** Possible Points: **108**

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

R = Responsibility
 C = Contractor
 D = Design

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Table 4-1 Target CREL VOCs and their maximum allowable concentrations

No.	Compound Name	CAS No.	Allowable Conc. ^a (µg/m ³)
1	Acetaldehyde	75-07-0	70
2	Benzene	71-43-2	30
3	Carbon disulfide	75-15-0	400
4	Carbon tetrachloride	56-23-5	20
5	Chlorobenzene	108-90-7	500
6	Chloroform	67-66-3	150
7	Dichlorobenzene (1,4-)	106-46-7	400
8	Dichloroethylene (1,1)	75-35-4	35
9	Dimethylformamide (N,N-)	68-12-2	40
10	Dioxane (1,4-)	123-91-1	1,500
11	Epichlorohydrin	106-89-8	1.5
12	Ethylbenzene	100-41-4	1,000
13	Ethylene glycol	107-21-1	200
14	Ethylene glycol monoethyl ether	110-80-5	35
15	Ethylene glycol monoethyl ether acetate	111-15-9	150
16	Ethylene glycol monomethyl ether	109-86-4	30
17	Ethylene glycol monomethyl ether acetate	110-49-6	45
18	n/a	n/a	n/a
19	Hexane (n-)	110-54-3	3,500
20	Isophorone	78-59-1	1,000
21	Isopropanol	67-63-0	3,500
22	Methyl chloroform	71-55-6	500
23	Methylene chloride	75-09-2	200
24	Methyl <i>t</i> -butyl ether	1634-04-4	4,000
25	Naphthalene	91-20-3	4.5
26	Phenol	108-95-2	100
27	Propylene glycol monomethyl ether	107-98-2	3,500
28	Styrene	100-42-5	450
29	Tetrachloroethylene	127-18-4	17.5
30	Toluene	108-88-3	150
31	Trichloroethylene	79-01-6	300
32	Vinyl acetate	108-05-4	100
33-35	Xylenes, technical mixture (m-, o-, p-xylene combined)	108-38-3, 95-47-6, 106-42-3	350

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a) Refer to http://www.oehha.ca.gov/air/chronic_rels/AllChrels.html. All maximum allowable concentrations are one-half the corresponding CREL adopted by Cal/EPA OEHHA with the exception of formaldehyde. For any future changes in the CREL list by OEHHA, values in Table 4.1 shall continue to apply until these changes are published in the Standard Method.

END OF SECTION

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**SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS**

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PART 1 – GENERAL

1.1. SUMMARY

- A. Purpose: Define the responsibilities of the parties involved and the procedures related to the commissioning process

1.2. RELATED SPECIFICATIONS

- A. Section 01 31 13 Project Management and Coordination
B. Section 01 31 19 Project Meetings
C. Section 01 31 23 Project Management
D. Section 01 32 26 Construction Progress Reporting
E. Section 01 33 23 Submittals
F. Section 01 45 16 Field Quality Control
G. Section 01 77 00 Closeout Procedures
H. Section 01 78 23 Operation and Maintenance Data
I. Section 01 78 39 As-Built Drawings
J. Section 01 79 00 Demonstration and Training
K. Section 01 81 13 Sustainable Design Requirements
L. Section 01 95 00 Measurement & Verification
M. Section 23 05 93 Testing, Adjusting, and Balancing for HVAC
N. Section 23 09 00 Instrumentation and Control for HVAC
O. Section 23 09 23 Direct Digital Control (DDC) System for HVAC
P. Section 23 09 93 Sequence of Operations for HVAC DDC

1.3 REFERENCES

- A. ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for The Commissioning Process".
B. ASHRAE Guideline 0-2005, "The Commissioning Process".
C. NEBB – Procedural Standards for Building Systems Commissioning.

1
2 **1.4 DEFINITIONS**

- 3 A. Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests,
4 O&M documentation review and training occurs.
- 5 B. Approval: Acceptance that a piece of equipment or system has been properly installed and is functioning in the
6 tested modes according to the Contract Documents.
- 7 C. Architect/Engineer (A/E): The prime consultant (architect) and sub-consultants who comprise the design team,
8 generally the HVAC mechanical designer/engineer and the electrical designer/engineer.
- 9 D. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to
10 meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document
11 includes both narrative descriptions and lists of individual items that support the design process.
- 12 E. CxP: Commissioning Provider. An independent entity, not otherwise associated with the A/E team members or
13 the Contractor, hired by the Owner. The CxP directs and coordinates the day-to-day commissioning activities.
14 The CxP does not take an oversight role like the CM. The CxP is part of the Construction Manager (CM) team or
15 shall report directly to the CM.
- 16 F. Cx Plan: Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and
17 documentation requirements of the commissioning process.
- 18 G. Data Logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers
19 separate from the control system.
- 20 H. Deferred Functional Tests: FPTs that are performed later, after substantial completion, due to partial occupancy,
21 equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.
- 22 I. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not
23 in compliance with the Contract Documents (that is, does not perform properly or is not complying with the
24 design intent)
- 25 J. Design Intent: A dynamic document that provides the explanation of the ideas, concepts and criteria that are
26 considered to be very important to the owner. It is initially the outcome of the programming and conceptual
27 design phases.
- 28 K. Design Narrative or Design Documentation: Sections of either the Design Intent or Basis of Design.
- 29 L. Factory Testing: Testing of equipment on-site or at the factory-by-factory personnel with an Owner's
30 representative present.
- 31 M. Functional Performance Test (FPT): Test of the dynamic function and operation of equipment and systems using
32 manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather
33 than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions
34 to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under
35 various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying
36 outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's
37 sequences of operation and components are verified to be responding as the sequences state. Traditional air or
38 water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary
39 work is setting up the system flows and pressures as specified, while functional testing is verifying that which has
40 already been set up. The Commissioning Provider develops the functional test procedures in a sequential
41 written form, coordinates, oversees and documents the actual testing, which is usually performed by the
42 installing contractor or vendor. FPTs are performed after prefunctional checklists and startup are complete.
- 43 N. General Contractor (GC): The prime contractor for this project. Generally, refers to all the GC's subcontractors
44 as well. Also referred to as the Contractor, in some contexts.
- 45 O. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen
46 reporting a damper to be 100% closed.
- 47 P. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify
48 performance (contrasted to analyzing monitored data taken over time to make the "observation").
- 49 Q. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using
50 dataloggers or the trending capabilities of control systems.
- 51 R. Non-Compliance: See Deficiency.
- 52 S. Non-Conformance: See Deficiency.
- 53 T. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g.,
54 changing the outside air temperature value from 50F to 75F to verify economizer operation). See also
55 "Simulated Signal."
- 56 U. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the
57 expectations of how it will be used and operated. These include Project goals, measurable performance criteria,
58 cost considerations, benchmarks, success criteria, and supporting information.

- 1 V. Pre-Functional Checklist (PFC): A list of items to inspect and elementary component tests to conduct to verify
2 proper installation of equipment, provided by the CxP to the Sub. Prefunctional checklists are primarily static
3 inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels
4 OK, labels affixed, gages in place, sensors calibrated, etc.). However, some prefunctional checklist items entail
5 simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage
6 imbalance on a three-phase pump motor of a chiller system). The word prefunctional refers to before functional
7 testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist. Even
8 without a commissioning process, contractors typically perform some, if not many, of the prefunctional checklist
9 items a Commissioning Provider will recommend. However, few contractors document in writing the execution
10 of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own.
11 The Commissioning Provider only requires that the procedures be documented in writing, and does not witness
12 much of the prefunctional checklisting, except for larger or more critical pieces of equipment.
- 13 W. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of
14 equipment.
- 15 X. Seasonal Performance Tests: FPTs that are deferred until the system(s) experience conditions closer to their
16 design conditions.
- 17 Y. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying
18 a hair blower to a space sensor to see the response in a VAV box).
- 19 Z. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or
20 pressure to the transducer and DDC system to simulate a sensor value.
- 21 AA. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they
22 shall mean "as-built" systems, subsystems, equipment, and components.
- 23 BB. Startup: The initial starting or activating of dynamic equipment, including executing prefunctional checklists.
- 24 CC. Subs: The subcontractors to the GC who provide and install building components and systems.
- 25 DD. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test
26 procedures are developed by the CxP.
- 27 EE. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test
28 requirements are not the detailed test procedures. The test requirements are specified in the Contract
29 Documents
- 30 FF. Trending: Monitoring using the building control system.
- 31 GG. Vendor: Supplier of equipment.
- 32 HH. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at
33 Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract
34 Documents and accepted submittals.

35 36 **1.5 DESCRIPTION**

- 37 A. General: Commissioning (Cx) is a systematic process of verifying that all building systems perform interactively to
38 meet the Owner's Project Requirements (OPR). This is achieved by beginning in the planning phase with
39 documenting the OPR and continuing through design, construction, acceptance, and the warranty period with
40 verification of performance. The Cx process shall encompass and coordinate the traditionally separate functions
41 of system documentation, equipment startup, control system calibration, testing and balancing, performance
42 testing and training. Cx during the construction phase is intended to achieve the following specific objectives
43 according to the Contract Documents:
- 44 1. Verify that applicable equipment and systems are installed according to the manufacturer's
45 recommendations and to industry accepted minimum standards and that they receive adequate
46 operational checkout by installing contractors.
 - 47 2. Verify and document proper performance of equipment and systems.
 - 48 3. Verify that O&M documentation is complete.
 - 49 4. Verify that the Owner's operating personnel are adequately trained.
 - 50 5. The Cx process does not take away from or reduce the responsibility of the system designers or
51 installing contractors to provide a finished and fully functioning product.
- 52 B. The Commissioning Provider(CxP) has no authority to change, modify or direct any work. The CxP can only
53 provide comments and suggestions.
- 54 C. Commissioning Plan: The Cx Plan provides guidance in the execution of the Cx process. The CxP will update the
55 Cx Plan regularly as the project progresses. The Drawings and Specifications will take precedence over the Cx
56 Plan.
- 57 D. Commissioning Team: The members of the commissioning team consist of the Commissioning Provider (CxP),
58 the Owner's Representative (OR), the designated representative of the owner's Construction Management firm

- 1 (CM), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical
2 engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls
3 Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or
4 plant operator/engineer is also a member of the commissioning team.
- 5 E. Management: The CxP is hired by the Owner directly. The CxP directs and coordinates the commissioning
6 activities and the reports to the OR. All members work together to fulfill their contracted responsibilities and
7 meet the objectives of the Contract Documents.
- 8 F. Scheduling: The CxP will work with the CM and GC according to established protocols to schedule the
9 commissioning activities. The CxP will provide sufficient notice to the CM and GC for scheduling commissioning
10 activities. The GC will integrate all commissioning activities into the master schedule. All parties will address
11 scheduling problems and make necessary notifications in a timely manner in order to expedite the
12 commissioning process.
- 13 G. The CxP will provide the initial schedule of primary commissioning events at the commissioning scoping meeting.
14 The Commissioning Plan provides a format for this schedule. As construction progresses, more detailed
15 schedules are developed by the CxP. The Commissioning Plan also provides a format for detailed schedules.
16

17 1.6 RESPONSIBILITIES

- 18 A. Owner
- 19 1. Provide the OPR documentation to the CxP and Contractor for information and use.
- 20 2. Assign operation and maintenance personnel and schedule them to participate in commissioning
21 team activities.
- 22 3. Provide the BOD documentation, prepared by Architect and approved by Owner, to the CxP and
23 Contractor for use in developing the commissioning plan, systems manual, and operation and
24 maintenance training plan.
- 25 4. Follow the Commissioning Plan.
- 26 5. Attend commissioning scoping meetings and additional meetings as necessary.
- 27 B. Architect/Engineer (AE)
- 28 1. The AE shall participate in and perform commissioning process activities including, but not limited
29 to, the following:
- 30 a. Attend the commissioning scoping meeting and selected commissioning team meetings.
- 31 b. Perform normal submittal review, construction observation, as-built drawing preparation,
32 O&M manual preparation, etc., as contracted.
- 33 c. Provide any design narrative and sequence documentation requested by the CxP. The
34 designers shall assist (along with the contractors) in clarifying the operation and control of
35 commissioned equipment in areas where the specifications, control drawings or
36 equipment documentation is not sufficient for writing detailed testing procedures.
- 37 d. Coordinate resolution of system deficiencies identified during commissioning, according to
38 the contract documents.
- 39 e. Prepare and submit final as-built design intent documentation for inclusion in the O&M
40 manuals. Review and approve the O&M manuals.
- 41 f. Coordinate resolution of design non-conformance and design deficiencies identified during
42 warranty-period commissioning.
- 43 g. Participate in the resolution of non-compliance, non-conformance and design deficiencies
44 identified during commissioning during warranty-period commissioning.
- 45 C. General Contractor (GC)
- 46 1. Construction and Acceptance Phase
- 47 a. Assist the Construction Manager CM in the coordination of the Cx work by the CxP, and
48 with the CM and CxP ensure that Cx activities are being scheduled into the master
49 schedule.
- 50 b. Provide an updated construction schedule to the CxP any time the schedule changes.
- 51 c. Include the Cx activities in the contract and account for the cost of commissioning in the
52 total contract price.
- 53 d. Attend commissioning team meetings as needed.
- 54 e. Furnish a copy of all submittals and shop drawings pertaining to the commissioned
55 systems for review concurrently with the Architect and Engineers.
- 56 f. Furnish a copy of all construction meeting agendas and minutes to the CxP.
- 57 g. In each purchase order or subcontract written, include requirements for submittal data,
58 O&M data, Cx tasks and training.

- 1 h. GC will ensure that all Subs execute their Cx responsibilities according to the Contract
- 2 Documents and schedule.
- 3 i. A representative from the GC and each sub associated with the Cx process shall attend the
- 4 Cx pre- construction meeting and the regular Cx meetings scheduled by the CxP to
- 5 facilitate the Cx process.
- 6 j. Coordinate and execute the training of Owner personnel.
- 7 k. Prepare O&M manuals, according to the Contract Documents, including clarifying and
- 8 updating the original sequences of operation to as-built conditions.
- 9 l. Prepare and submit draft forms, including but not limited to start-up procedures, Testing
- 10 and Balancing (TAB) forms, calibration forms, etc. for review by the CxP before execution.
- 11 m. Submit test reports to the CxP of all tests performed on components and equipment to be
- 12 commissioned that are not included as part of the Construction Checklist and SPT
- 13 procedures.
- 14 n. Complete all construction checklist and functional performance test forms as required by
- 15 the Cx process.
- 16 o. Review and accept construction checklists provided by the CxP.
- 17 p. Support the CxP with verification of the completion of construction checklist and
- 18 functional performance tests as outlined in PART 3.
- 19 q. Complete paper or electronic construction checklists as work is completed and provide to
- 20 the CxP.
- 21 r. Complete and inspect all installations. Certify that all components and systems are
- 22 operating as intended per Contract Documents.
- 23 s. Complete commissioning process test procedures
- 24 t. Evaluate performance deficiencies identified in test reports and, in collaboration with
- 25 entity responsible for system and equipment installation, recommend corrective action.
- 26 u. Remedy all deficiencies immediately as they are identified throughout construction.
- 27 v. Demonstrate functionality of all systems and equipment.
- 28 w. Cooperate with the CxP for resolution of issues recorded in the Issues Log
- 29 x. Maintain an updated set of record drawings (daily) on the construction site.
- 30 y. Provide support and instrumentation to verify TAB reports, start-up reports, calibration
- 31 reports, and any other report pertinent to the commissioned equipment and systems.
- 32 z. Notify the CxP no less than 21 days before all testing, start-up, and training.
- 33 aa. Update the CxP on a weekly basis on the progress of the Cx activities.
- 34 bb. Coordinate the training of Owner personnel and provide the training plan, times, and
- 35 dates to the CxP.
- 36 cc. Submit trend data in electronic format or allow access to trending data by internet
- 37 connection as requested by the CxP.
- 38 dd. Install access points by every sensor such that the sensor can be calibrated without
- 39 removal (P/T plugs, plugged holes in ducts etc.).
- 40 2. Warranty Period
- 41 a. Execute seasonal or deferred functional performance testing, witnessed by the CxP,
- 42 according to the specifications.
- 43 b. Correct deficiencies and make necessary adjustments to O&M manuals and record
- 44 drawings for applicable issues identified in any seasonal testing.
- 45 c. Submit trend data in electronic format as specified by the CxP or allow access to trending
- 46 data by internet connection as requested by the CxP.
- 47 d. Attend monitoring-based commissioning team meetings as needed.
- 48 D. Subcontractors
- 49 1. Contractor shall assign representatives with expertise and authority to act on its behalf and shall
- 50 schedule them to participate in and perform commissioning process activities including, but not
- 51 limited to, the following:
- 52 a. Provide all requested submittal data, including detailed start-up procedures and specific
- 53 responsibilities of the Owner to keep warranties in force.
- 54 b. Assist in equipment testing per agreements with Prime.
- 55 c. Include all special tools and instruments (only available from vendor, specific to a piece of
- 56 equipment) required for testing equipment according to these Contract Documents in the
- 57 base bid price to the Contractor, except for stand-alone data logging equipment that may
- 58 be used by the CxP.

- 1 d. Provide information requested by CxP regarding equipment sequence of operation and
2 testing procedures.
3 e. Review test procedures for equipment installed by factory representatives.
4 f. Complete paper or electronic construction checklists as work is completed and provide to
5 the CxP.
6 g. Follow the Commissioning Plan
7 h. Attend commissioning scoping meetings and additional meetings as necessary.
- 8 E. Equipment Suppliers
- 9 2. The equipment suppliers shall assign representatives with expertise and authority to act on its
10 behalf and shall schedule them to participate in and perform commissioning process activities
11 including, but not limited to, the following:
- 12 a. Provide all requested submittal data, including detailed start-up procedures and specific
13 responsibilities of the Owner to keep warranties in force.
14 b. Assist in equipment testing per agreements with Subs.
15 c. Include all special tools and instruments (only available from vendor, specific to a piece of
16 equipment) required for testing equipment according to these Contract Documents in the
17 base bid price to the Contractor, except for stand-alone datalogging equipment that may
18 be used by the CxP.
19 d. Through the contractors they supply products to, analyze specified products and verify
20 that the designer has specified the newest most updated equipment reasonable for this
21 project's scope and budget.
22 e. Provide information requested by CxP regarding equipment sequence of operation and
23 testing procedures, including a list of final settings, setpoints, ranges, schedules, and / or
24 trend logs required by the CxP.
25 f. Provide the CxP with Building Automation System trend data files as described in Section
26 01 91 00, Part 3, Subsection 3.7.E, Building Automation System Trending.
27 g. Review test procedures for equipment installed by factory representatives.
28 h. Follow the Commissioning Plan.
29 i. Attend commissioning scoping meetings and additional meetings as necessary.
- 30 F. Commissioning Provider (CxP)
- 31 3. The CxP is not responsible for design concept, design criteria, compliance with codes, design or
32 general construction scheduling, cost estimating, or construction management. The CxP may
33 assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility
34 resides with the general contractor and the A/E. The primary role of the CxP is to develop and
35 coordinate the execution of a testing plan, observe and document performance—that systems are
36 functioning in accordance with the documented design intent and in accordance with the
37 Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out
38 and functionally test equipment and systems:
- 39 a. Coordinate and direct the commissioning activities using consistent protocols and forms,
40 centralized documentation, clear and regular communications and consultations with all
41 necessary parties, frequently updated timelines and schedules and technical expertise.
42 b. Coordinate the commissioning work and, with the GC and CM, ensure that commissioning
43 activities are being scheduled into the master schedule.
44 c. Revise, as necessary, the Commissioning Plan.
45 d. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
46 e. Request and review additional information required to perform commissioning tasks,
47 including O&M materials, contractor start-up and checkout procedures.
48 f. Gather and review the current control sequences and interlocks and work with contractors
49 and design engineers until sufficient clarity has been obtained, in writing, to be able to
50 write detailed testing procedures.
51 g. Review and comment on normal Contractor submittals applicable to systems being
52 commissioned for compliance with commissioning needs, concurrent with the A/E
53 reviews.
54 h. Write and distribute prefunctional tests and checklists.
55 i. Develop an enhanced start-up and initial systems checkout plan with Subs.
56 j. Perform site visits, as necessary, to observe components and system installations. Attends
57 selected planning and job-site meetings to obtain information on construction progress.

- 1 Review construction meeting minutes for revisions/substitutions relating to the
2 commissioning process. Assist in resolving any discrepancies.
- 3 k. Witness all or part of the HVAC piping test and flushing procedure, sufficient to be
4 confident that proper procedures were followed. Document this testing and include the
5 documentation in O&M manuals. Notify the owner’s representative of any deficiencies in
6 results or procedures.
- 7 l. Witness all or part of any ductwork testing and cleaning procedures, sufficient to be
8 confident that proper procedures were followed. Document this testing and include the
9 documentation in O&M manuals. Notify the owner’s representative of any deficiencies in
10 results or procedures.
- 11 m. Approve prefunctional tests and checklist completion by reviewing prefunctional checklist
12 reports and by selected site observation and spot checking.
- 13 n. Approve systems startup by reviewing start-up reports and by selected site observation.
- 14 o. Review TAB execution plan.
- 15 p. Approve air and water systems balancing by spot testing, by reviewing completed reports
16 and by selected site observation.
- 17 q. With necessary assistance and review from the installing contractors, write the functional
18 performance test procedures for equipment and systems. This may include energy
19 management control system trending, stand-alone datalogger monitoring or manual
20 functional testing. Submit to CM for review, and for approval if required.
- 21 r. Analyze any functional performance trend logs and monitoring data to verify performance.
- 22 s. Coordinate, witness and approve manual functional performance tests performed by
23 installing contractors. Coordinate retesting as necessary until satisfactory performance is
24 achieved.
- 25 t. Maintain a master deficiency and resolution log and a separate testing record. Provide the
26 CM with written progress reports and test results with recommended actions.
- 27 u. Review equipment warranties to ensure that the Owner’s responsibilities are clearly
28 defined.
- 29 v. Oversee and approve the training of the Owner’s operating personnel.
- 30 w. Compile and maintain a commissioning record.
- 31 x. Review and approve the preparation of the O&M manuals.
- 32 y. Provide a final commissioning report.
- 33 z. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
- 34 aa. Return to the site within 10 months into the 12 month warranty period and review with
35 facility staff the current building operation and the condition of outstanding issues related
36 to the original and seasonal commissioning. Also interview facility staff and identify
37 problems or concerns they have operating the building as originally intended. Make
38 suggestions for improvements and for recording these changes in the O&M manuals.
39 Identify areas that may come under warranty or under the original construction contract.
40 Assist facility staff in developing reports, documents and requests for services to remedy
41 outstanding problems
42

43 **1.7 SYSTEMS TO BE COMMISSIONED**

- 44 A. The entire Heating, Ventilation and Air Conditioning (HVAC) system (boilers, chillers, pumps, piping and air
45 distribution systems)
- 46 B. Building Automation System (BAS) for the HVAC system
- 47 C. Domestic Hot Water
- 48 D. Building envelope and roofing system
- 49 E. Lighting and Lighting Controls
- 50 F. Solar electric (PV) System
- 51 G. Emergency Power System
- 52

53 **PART 2 – PRODUCTS**

54

55 **2.1 TEST INFORMATION**

- 56 A. All instruments needed to verify sensor readings, component performance, and system performance will be
57 provided by GC and Subs and be available to the CxP. These instruments will not be beyond what the contractors

- 1 need to complete the work specified in these construction documents. Any data logging equipment required in
2 addition to the BAS will be provided by the CxP.
- 3 B. All instruments shall be of sufficient quality and accuracy to test and/or measure system performance with the
4 tolerances specified in the Contract Documents. Refer to specification section 23 05 93- Testing, Adjusting, and
5 Balancing for required instrument tolerances.
- 6 C. All standard testing equipment required to perform startup and initial checkout and required functional
7 performance testing shall be provided by the Division contractor for the equipment being tested. For example,
8 the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for
9 the HVAC system and controls system in Division 23, except for equipment specific to and used by TAB in their
10 commissioning responsibilities. Two-way radios shall be provided by the Division Contractor.
- 11 D. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required
12 for testing equipment, according to these Contract Documents shall be included in the base bid price to the
13 Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CxP.
- 14 E. Standalone datalogging equipment and software used by the CxP to test equipment shall not become the
15 property of the Owner.
- 16 F. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with
17 the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements
18 apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an
19 accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the
20 value range being measured (not full range of meter) and have been calibrated within the last year. All
21 equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or
22 damaged. Calibration tags shall be affixed or certificates readily available.

23 **PART 3 - EXECUTION**

24 **3.1 COMMISSIONING TEAM**

- 25
- 26 A. The members of the commissioning team consist of the Commissioning Authority (CxP), the Owner's Project
27 Manager (PM), the designated representative of the Owner's Construction Management team (CM), the General
28 Contractor (GC or Contractor), the architect and design engineers, the Mechanical Contractor, the Electrical
29 Contractor, the TAB Contractor, the Controls Contractor, any other installing subcontractors or suppliers of
30 equipment.
- 31 1. Members Appointed by Owner:
- 32 a. CxP: The designated person, company, or entity that plans, schedules, and coordinates the
33 commissioning team to implement the commissioning process
- 34 b. Representatives of the facility user and operation and maintenance personnel
- 35 c. Owners representative
- 36 d. Architect and engineering design professionals
- 37 2. Members Appointed by Contractor(s): Members Appointed by Contractor(s): Individuals, each
38 having the authority to act on behalf of the entity he or she represents, explicitly organized to
39 implement the commissioning process through coordinated action. The commissioning team shall
40 consist of, but not be limited to, the Construction Manager (CM) and representatives of the
41 Contractor, including Project superintendent and subcontractors, installers, suppliers, and
42 specialists deemed appropriate by the CxP
- 43
- 44 B. Each Cx Team member shall designate one person who is responsible for coordinating the commissioning efforts
45 with the CxP.
- 46

47 **3.2 SCHEDULING AND MEETINGS**

- 48 A. Scheduling: The CxP will work with the other members of the Cx Team according to established protocols to
49 schedule the Cx activities. The CxP will provide sufficient notice to the Cx Team for scheduling Cx activities. The
50 GC will integrate all Cx activities into the master schedule. All parties will address scheduling problems and make
51 necessary notifications in a timely manner in order to expedite the Cx process.
- 52 B. The CxP will provide the initial schedule of primary Cx events at the Cx pre-construction meeting. The Cx Plan
53 provides a format for this schedule. As construction progresses more detailed schedules are developed by the
54 CxP. The Cx Plan also provides a format for detailed schedules.
- 55 C. Scoping Meeting: Within 90 days of commencement of construction, the CxP will schedule, plan and conduct a
56 commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be
57 distributed to all parties by the CxP. Information gathered from this meeting will allow the CxP to revise the
58 Commissioning Plan to its "final" version, which will also be distributed to all parties.

- 1 D. Miscellaneous Meetings: The Cx meetings will be scheduled approximately once a month during construction.
2 These meetings will be scheduled directly before or after the regular construction meetings if practical. These
3 meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CxP will plan
4 these meetings and will minimize unnecessary time being spent by Subs. These meetings may be held monthly or
5 weekly as required or as the end of construction draws closer.
6

7 **3.3 REPORTING**

- 8 A. The CxP will provide regular reports to the Owner as construction and Cx progresses. Standard forms are
9 provided and referenced in the Cx Plan.
10 B. The CxP will regularly communicate with all members of the Cx team, keeping them apprised of Cx progress and
11 scheduling changes through memos, progress reports, etc.
12 C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and
13 testing as described in later sections.
14 D. A final summary report by the CxP will be provided to the CM and OR. All acquired documentation, logs,
15 minutes, reports, deficiency lists, communications, findings, unresolved issues, Prefunctional checklists,
16 functional tests, monitoring reports, etc will be compiled in appendices and provided with the summary report
17

18 **3.4 RECORD DRAWINGS**

- 19 A. The CxP will verify that the record drawings are updated throughout the construction. If a discrepancy is found
20 between the record drawings and the installations, the CxP will notify the GC immediately. It is the GC and
21 subcontractors' responsibility to then inspect the installations and immediately and completely update the
22 record drawings such that they accurately reflect the installation.
23

24 **3.5 SUBMITTALS**

- 25 A. At minimum, the submittals for commissioned equipment shall include the manufacturer and model number,
26 the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data,
27 performance data, any performance test procedures, control drawings and details of owner contracted tests. In
28 addition, the installation and checkout materials that are shipped inside the equipment and the actual field
29 checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning
30 Provider. All documentation requested by the CxP will be included by the Subs in their O&M manual
31 contributions. The CxP may provide appropriate contractors with specific requests for the type of submittal
32 documentation the CxP requires to facilitate the commissioning work. These requests will be integrated into the
33 normal submittal process and protocol of the construction team.
34 B. The submittals requested by the CxP are listed in Table 1 at the end of this Section.
35 C. The Commissioning Provider will review and provide comment on submittals related to the commissioned
36 equipment for conformance to the Contract Documents as it relates to the commissioning process, to the
37 functional performance of the equipment and adequacy for developing test procedures. This review is intended
38 primarily to aid in the development of functional testing procedures and only secondarily to verify compliance
39 with equipment specifications. The Commissioning Provider will notify the CM, Owner Representative, or A/E as
40 requested, of items missing or areas that are not in conformance with Contract Documents and which require
41 resubmission.
42 D. The CxP may request additional design narrative from the A/E and Controls Contractor, depending on the
43 completeness of the design intent documentation and sequences provided with the Specifications.
44 E. These submittals to the CxP do not constitute compliance for O&M manual documentation. The O&M manuals
45 are the responsibility of the Contractor, though the CxP will review and approve them.
46 F. Contractor's responsibility for deviations in submittals from requirements of the Contract Documents is not
47 relieved by the Commissioning Provider's review.
48

49 **3.6 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT**

- 50 A. The following procedures apply to all equipment to be commissioned, according to Section 01 91 00, Part 1,
51 subsection 1.5, Systems to be Commissioned. Some systems that are not comprised so much of actual dynamic
52 machinery, e.g., electrical system power quality, may have very simplified prefunctional checklists and startup.
53 B. General. Prefunctional checklists are important to ensure that the equipment and systems are connected and
54 operational. This ensures that functional performance testing (in-depth system checkout) may proceed without
55 unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are
56 used. The prefunctional testing for a given system must be successfully completed prior to formal functional
57 performance testing of equipment or subsystems of the given system.

- 1 C. Start-up and Initial Checkout Plan. The CxP shall assist the commissioning team members responsible for startup
2 of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxP in this
3 process is to ensure that there is written documentation that each of the manufacturer-recommended
4 procedures have been completed. Parties responsible for prefunctional checklists and startup are identified in
5 the commissioning scoping meeting and in the checklist forms. Parties responsible for executing functional
6 performance tests are identified in the testing requirements in the applicable Division Sections.
- 7 3. The CxP adapts, if necessary, representative prefunctional checklists and procedures based on
8 requirements in the specifications for startup and initial checkout of the systems and the party
9 responsible for their execution.
- 10 4. The checklists and tests are provided by the CxP to the Contractor. The Contractor determines
11 which trade is responsible for executing and documenting each of the line item tasks and notes
12 that trade on the form. Each form may have more than one trade responsible for its execution. A
13 sample checklist is provided at the end of this specification section.
- 14 5. The subcontractor responsible for the purchase of the equipment develops the full start-up plan
15 by combining (or adding to) the CxP's checklists with the manufacturer's detailed start-up and
16 checkout procedures from the O&M manual and the normally used field checkout sheets. The
17 plan will include checklists and procedures with specific boxes or lines for recording and
18 documenting the checking and inspections of each procedure and a summary statement with a
19 signature block at the end of the plan. The full start-up plan could consist of something as simple
20 as:
- 21 a. The CxP's prefunctional checklists.
22 b. The manufacturer's standard written start-up procedures copied from the installation
23 manuals with check boxes by each procedure and a signature block added by hand at the
24 end.
25 c. The manufacturer's normally used field checkout sheets.
- 26 6. The subcontractor submits the full startup plan to the CxP for review and approval.
27 7. The CxP reviews and approves the procedures and the format for documenting them, noting any
28 procedures that need to be added.
29 8. The full start-up procedures and the approval form may be provided to the CM for review and
30 approval, depending on management protocol.
- 31 D. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the CM, GC and CxP. The
32 performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or
33 vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of
34 completion of their work.
- 35 E. The CxP may observe the procedures for each piece of equipment, unless there are multiple units, (in which case
36 a sampling strategy may be used).
- 37 F. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxP shall observe a
38 sampling of the prefunctional and start-up procedures.
- 39 G. The Subs and vendors shall execute startup and provide the CxP with a signed and dated copy of the completed
40 start-up and prefunctional tests and checklists.
- 41 H. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist
42 was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill
43 out these forms.
- 44 I. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
- 45 1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional
46 procedures that were not completed successfully, at the bottom of the procedures form or on an
47 attached sheet. The procedures form and any outstanding deficiencies are provided to the CxP
48 within two days of test completion.
- 49 2. The CxP reviews the report and submits either a non-compliance report or an approval form to
50 the Sub or CM. The CxP shall work with the Subs and vendors to correct and retest deficiencies or
51 uncompleted items. The CxP will involve the CM and others as necessary. The installing Subs or
52 vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a
53 timely manner and shall notify the CxP as soon as outstanding items have been corrected and
54 resubmit an updated start-up report and a Statement of Correction on the original non-
55 compliance report. When satisfactorily completed, the CxP recommends approval of the
56 execution of the checklists and startup of each system to the CM using a standard form.
- 57 3. Items left incomplete, which later cause deficiencies or delays during functional testing may result
58 in back charges to the responsible party. Refer to Part 3.7 herein for details.

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3.7 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. The general list of equipment to be commissioned is found in Section 1.7. The specific equipment and modes to be tested are described in the Cx Plan.
- C. The parties responsible to execute each test are listed with each test in the Cx Plan.
- D. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
 - 1. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
 - 2. Development of Test Procedures. Before test procedures are written, the CxP shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The CxP shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test shall provide limited assistance to the CxP in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxP shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CxP may submit the tests to the A/E for review, if requested.
 - 3. The CxP shall review owner-contracted, factory testing or required owner acceptance tests which the CxP is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the Specifications. Redundancy of testing shall be minimized.
 - 4. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.
 - 5. The test procedure forms developed by the CxP shall include (but not be limited to) the following information:
 - a. System and equipment or component name(s)
 - b. Equipment location and ID number
 - c. Date
 - d. Project name
 - e. Participating parties
 - f. Formulas used in any calculations
 - g. Required pre-test field measurements
 - h. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
 - i. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
 - j. A section for comments
 - k. Signatures and date block for the CxP
 - l. A sample Functional Performance Test form is provided at the end of this specification section.
- E. Building Automation System Trending.
 - 1. To enable comprehensive testing through trend data analysis, the contractor shall provide the CxP with the following:
 - a. A complete points list of all systems and components accessible by the Building Automation System, including BAS addresses, point descriptions, measured units, and corresponding design-drawing point names;
 - b. A controls schematic for all systems and components, including sensor point designations;
 - c. A sample trend data file generated by the BAS, fulfilling the requirements in section 3.7.E.1.d

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- d. Trend data files, for all system points selected by the CxP, according to the following requirements:
- 1) All data should be saved, where possible, in one file. If not feasible, then on as few files as possible.
 - 2) The data must be arranged in rows and columns
 - 3) Clear date and time stamps for each data recording
 - 4) The sampling rate must be constant, every 5 minutes.
 - 5) All data recordings must be from the same time period.
 - 6) Data point names must be clearer shown.
2. Where applicable, the above-mentioned Building Automation System Trending requirements may be adjusted according to coordination with the CxP.
- F. Test Methods.
1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. The CxP may substitute specified methods or require an additional method to be executed, other than what was specified, with the approval of the CM. This may require a change order and adjustment in charge to the Owner. The CxP will determine which method is most appropriate for tests that do not have a method specified.
 2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
 3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
 4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
 5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
 6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
 7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
 8. Sampling. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in prefunctional checklist execution.
 - a. A common sampling strategy, the "xx% Sampling—yy% Failure Rule", is defined by the following example.
 - b. xx = the percent of the group of identical equipment to be included in each sample.
 - c. yy = the percent of the sample that if failing, will require another sample to be tested.
 - d. The example below describes a 20% Sampling—10% Failure Rule.

- 1) Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the “first sample.”
 - 2) If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).
 - 3) If 10% of the units in the second sample fail, test all remaining units in the whole group.
 - 4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxP may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.
- G. Coordination and Scheduling. The Subs shall provide sufficient notice to the CxP regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxP will schedule functional tests through the CM, GC and affected Subs. The CxP shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
1. In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CxP before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional performance testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
- H. Test Equipment. Refer to Section 019113, Part 2 for test equipment requirements.
- I. Problem Solving. The CxP may recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

3.8 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Construction Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 2. Verify that sensors with shielded cable are grounded only at one end.
 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 4. Tolerances for critical applications may be tighter.
- D. Sensors without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
 2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E. Sensors with Transmitters - Standard Application.
1. Disconnect sensor.
 2. Connect a signal generator in place of sensor.
 3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer’s resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.

10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. Flow Rate, Steam: 3 percent of design.
 9. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).
 10. Hot Water Coil and Boiler Water Temperature: 1.5 degrees F (0.8 degrees C).
 11. Cooling Coil, Chilled and Condenser Water Temperatures: 0.4 degrees F (0.2 degree C).
 12. Combustion Flue Temperature: 5.0 degrees F (2.8 degrees C).
 13. Oxygen and CO2 Monitors: 0.1 percentage points.
 14. CO Monitor: 0.01 percentage points.
 15. Natural Gas and Oil Flow Rate: 1 percent of design.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.9 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL

- A. Documentation. The CxP shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the CM for review and approval and to the Subs for review. The CxP will include the filled out forms in the O&M manuals.
- B. Non-Conformance.
1. The CxP will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the CM on a standard non-compliance form.
 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxP. In such cases the deficiency and resolution will be documented on the procedure form.
 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxP will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the CM.
 4. As tests progress and a deficiency is identified, the CxP discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - 1) The CxP documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. After the day's work, the CxP submits the non-compliance reports to the CM for signature, if required. A copy is provided to the Sub and CxP. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxP.

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- 2) The CxP reschedules the test and the test is repeated.
 - 3) If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - 4) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the CM and to the Sub representative assumed to be responsible.
 - 5) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
 - 6) The CxP documents the resolution process.
 - 7) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxP. The CxP reschedules the test and the test is repeated until satisfactory performance is achieved.
5. Cost of Retesting.
 - a. The cost for the Sub to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
 - b. For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CxP and CM will direct the retesting of the equipment once at no "charge" to the GC for their time. However, the CxP's and CM's time for a second retest will be charged to the GC, who may choose to recover costs from the responsible Sub.
 - c. The time for the CxP and CM to direct any retesting required because a specific prefunctional checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the GC, who may choose to recover costs from the party responsible for executing the faulty prefunctional test.
 - d. Refer to the sampling section of Section 019113, Part 3.6 for requirements for testing and retesting identical equipment.
 6. The Contractor shall respond in writing to the CxP and CM at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 7. The CxP retains the original non-conformance forms until the end of the project.
 8. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.
- C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CM or OR. In such case, the Contractor shall provide the Owner with the following:
1. Within one week of notification from the CM or OR, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM or OR within two weeks of the original notice.
 2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
 3. The CM or OR will determine whether a replacement of all identical units or a repair is acceptable.
 4. Two examples of the proposed solution will be installed by the Contractor and the CM will be allowed to test the installations for up to one week, upon which the CM or OR will decide whether to accept the solution.
 5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

- 1 D. Approval. The CxP notes each satisfactorily demonstrated function on the test form. Formal approval of the
2 functional performance test is made later after review by the CxP and by the CM, if necessary. The CxP
3 recommends acceptance of each test to the CM using a standard form. The CM gives final approval on each test
4 using the same form, providing a signed copy to the CxP and the Contractor.
5

6 **3.9 DEFERRED TESTING**

- 7 A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required
8 occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon
9 approval of the OR. These tests will be conducted in the same manner as the seasonal tests as soon as possible.
10 Services of necessary parties will be negotiated.
11 B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer
12 to the system's design) shall be completed as part of this contract. The CxP shall coordinate this activity. Tests
13 will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the
14 CxP witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made.
15

16 **3.10 TRAINING OF OWNER PERSONNEL**

- 17 A. The CM shall be responsible for training coordination and scheduling and ultimately for ensuring that training is
18 completed.
- 19 1. The CxP shall be responsible for overseeing and approving the content and adequacy of the
20 training of Owner personnel for commissioned equipment.
 - 21 2. The CxP shall interview the facility manager and lead engineer to determine the special needs and
22 areas where training will be most valuable. The Owner and CxP shall decide how rigorous the
23 training should be for each piece of commissioned equipment. The CxP shall communicate the
24 results to the Subs and vendors who have training responsibilities.
 - 25 3. In addition to these general requirements, the specific training requirements of Owner personnel
26 by Subs and vendors are specified in the Cx Plan.
 - 27 4. Each Sub and vendor responsible for training will submit a written training plan to the CxP for
28 review and approval prior to training. The plan will cover the following elements:
 - 29 a. Equipment (included in training)
 - 30 b. Intended audience
 - 31 c. Location of training
 - 32 d. Objectives
 - 33 e. Subjects covered (description, duration of discussion, special methods, etc.)
 - 34 f. Duration of training on each subject
 - 35 g. Instructor for each subject
 - 36 h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations,
37 written handouts, etc.)
 - 38 i. Instructor and qualifications
 - 39 j. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion
40 of the control of the equipment during the mechanical or electrical training conducted by
41 others.
 - 42 k. Means of training documentation (i.e. report, sign-in sheet, video recording, manual, etc).
 - 43 5. The CM/GC develops an overall training plan and coordinates and schedules, with the Owner and
44 CxP, the overall training for the commissioned systems. The CxP develops criteria for determining
45 that the training was satisfactorily completed, including attending some of the training, etc. The
46 CxP recommends approval of the training to the CM using a standard form. The CM also signs the
47 approval form at one of the training sessions; the CxP discusses the use of the blank functional
48 test forms for re-commissioning equipment.
 - 49 6. Video recording of the training sessions will be provided by the Trade Contractor with media
50 cataloged by the CM/GC and added to the O&M manuals.
 - 51 7. Training shall include presentation of the overall system concept and the concept of each
52 equipment section. This presentation shall include a review of all systems using the simplified
53 system schematics.
54

55 **3.11 OPERATION AND MAINTENANCE MANUALS**

- 56 A. Standard O&M Manuals.
- 57 1. The specific content and format requirements for the standard O&M manuals are detailed in the
58 Cx Plan and in Section 017823.

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2. Contractor shall submit at least an electronic copy of the complete operating and maintenance manual to the CM for review by the CxP.
 3. CxP Review and Approval. Prior to substantial completion, the CxP shall review the O&M manuals, documentation and redline as-builds for systems that were commissioned to verify compliance with the Specifications. The CxP will communicate deficiencies in the manuals to the CM, OR or A/E, as requested. Upon a successful review of the corrections, the CxP recommends approval and acceptance of these sections of the O&M manuals to the CM, OR or A/E. The CxP also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.
- B. Commissioning Record in O&M Manuals.
1. The CxP is responsible to compile, organize and index the commissioning data and deliver it to the GC, to be included with the O&M manuals.
 2. Final Report Details. The final commissioning report shall include an executive summary, overview of commissioning and testing scope and a general description of testing and verification methods. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.
 3. Other documentation will be retained by the CxP

3.12 SYSTEMS MANUAL

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- A. The GC and applicable Subs must supply the following documentation for inclusion in the systems manuals each commissioned system:
1. As-built system single line diagrams
 2. As-built sequences of operations, control drawings, and original set points
 3. Operating instructions for integrated building systems
 4. Recommended schedule of maintenance requirements and frequency for equipment
 5. Recommended schedule for calibrating sensors and actuators
- B. Prior to substantial completion, the applicable subcontractors shall submit an electronic copy of this documentation for their respective works to the CM for review by the CxP.

3.13 WRITTEN WORK PRODUCTS

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- A. The commissioning process generates several written work products described in various parts of the Specifications. In summary, the written products are:

<u>Product</u>	<u>Developed By</u>
1. Final commissioning plan	CxP
2. Cx meeting minutes	CxP
3. Commissioning schedules	CxP, GC, CM
4. Equipment documentation submittals	Subs
5. Prefunctional checklists	CxP
6. Startup and initial checkout plan	Subs, CxP (existing documents)
7. Startup and initial checkout forms filled out	Subs
8. Final TAB report	TAB
9. Issues log (deficiencies)	CxP
10. Deficiency Reports	CxP
11. Functional performance test forms	CxP
12. Completed functional performance test forms	CxP
13. O&M Manuals	Subs
14. Overall training plan	GC, CM
15. Specific training agendas	Subs
16. Monitoring Based Cx Plan	CxP
17. Final commissioning report	CxP
18. Miscellaneous approvals	CxP

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3.8 SAMPLE DOCUMENTS

A. The two documents after this section (Sample Construction Checklist and Sample System Performance Test) are included to demonstrate the level of effort and quality expected of the contractors. These documents will be revised as necessary as the project progresses.

END OF SECTION

SECTION 01 91 19
BUILDING ENCLOSURE COMMISSIONING

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PART 1 – GENERAL

1.1. SUMMARY

- 19
20 A. Purpose: Define the responsibilities of the parties involved and the procedures related to the building enclosure
21 commissioning process.
22

1.2. RELATED SPECIFICATIONS

- 23
24 A. Section 01 31 13 Project Management and Coordination
25 B. Section 01 31 19 Project Meetings
26 C. Section 01 31 23 Project Management
27 D. Section 01 32 26 Construction Progress Reporting
28 E. Section 01 33 23 Submittals
29 F. Section 01 45 16 Field Quality Control
30 G. Section 01 77 00 Closeout Procedures
31 H. Section 01 78 39 As-Built Drawings
32 I. Section 01 79 00 Demonstration and Training
33 J. Section 01 91 13 General Commissioning Requirements
34

1.3. DEFINITIONS

- 35
36 A. Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests,
37 O&M documentation review and training occurs.
38 B. Approval: Acceptance that a piece of equipment or system has been properly installed and is functioning in the
39 tested modes according to the Contract Documents.
40 C. Architect/Engineer (A/E): The prime consultant (architect) and sub-consultants who comprise the design team,
41 generally the HVAC heating and ventilation designer/engineer and the electrical designer/engineer.
42 D. DN: Design Narrative. A document that records concepts, calculations, decisions, and product selections used to
43 meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes
44 both narrative descriptions and lists of individual items that support the design process.
45 E. CxP: Commissioning Provider. An independent agent, not otherwise associated with the A/E team members or the
46 Contractor, hired by the OWNER. The CxP directs and coordinates the day-to-day commissioning activities.
47 F. Cx Plan: Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and
48 documentation requirements of the commissioning process.
49 G. Data Logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers
50 separate from the control system.
51 H. Deferred Functional Tests: FPTs that are performed later, after substantial completion, due to partial occupancy,
52 equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.
53 I. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in
54 compliance with the Contract Documents (that is, does not perform properly or is not complying with the design
55 intent)

- 1 J. Design Intent: A dynamic document that provides the explanation of the ideas, concepts and criteria that are
2 considered to be very important to the OWNER. It is initially the outcome of the programming and conceptual
3 design phases.
- 4 K. Design Narrative or Design Documentation: Sections of either the Design Intent or Design Narrative.
- 5 L. Factory Testing: Testing of equipment on-site or at the factory-by-factory personnel with Owner representative
6 present.
- 7 M. Functional Performance Test (FPT): Test of the dynamic function and operation of equipment and systems using
8 manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather
9 than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to
10 see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under
11 various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying
12 outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's
13 sequences of operation and components are verified to be responding as the sequences state. Traditional air or
14 water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary
15 work is setting up the system flows, and pressures as specified, while functional testing is verifying that which has
16 already been set up. The commissioning authority develops the functional test procedures in a sequential written
17 form, coordinates, oversees and documents the actual testing, which is usually performed by the installing
18 contractor or vendor. FPTs are performed after prefunctional checklists and startup are complete.
- 19 N. General Contractor (GC): The prime contractor for this project. Generally, refers to all the GC's subcontractors as
20 well. Also referred to as the Contractor, in some contexts.
- 21 O. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a
22 damper to be 100% closed.
- 23 P. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify
24 performance (contrasted to analyzing monitored data taken over time to make the "observation").
- 25 Q. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using
26 dataloggers or the trending capabilities of control systems.
- 27 R. Non-Compliance: See Deficiency.
- 28 S. Non-Conformance: See Deficiency.
- 29 T. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g.,
30 changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated
31 Signal."
- 32 U. OPR: Owner Project Requirements. A document that details the functional requirements of a project and the
33 expectations of how it will be used and operated. These include Project goals, measurable performance criteria,
34 cost considerations, benchmarks, success criteria, and supporting information.
- 35 V. Pre-Functional Checklist (PFC): A list of items to inspect and elementary component tests to conduct to verify
36 proper installation of equipment, provided by the CxP to the Sub. Prefunctional checklists are primarily static
37 inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels
38 OK, labels affixed, gages in place, sensors calibrated, etc.). However, some prefunctional checklist items entail
39 simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage
40 imbalance on a three-phase pump motor of a chiller system). The word prefunctional refers to before functional
41 testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist. Even
42 without a commissioning process, contractors typically perform some, if not many, of the prefunctional checklist
43 items a commissioning authority will recommend. However, few contractors document in writing the execution of
44 these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The
45 commissioning authority only requires that the procedures be documented in writing, and does not witness much
46 of the prefunctional checklist, except for larger or more critical pieces of equipment.
- 47 W. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.
- 48 X. Seasonal Performance Tests: FPTs that are deferred until the system(s) will experience conditions closer to their
49 design conditions.
- 50 Y. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying a
51 hair blower to a space sensor to see the response in a VAV box).
- 52 Z. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure
53 to the transducer and DDC system to simulate a sensor value.

- 1 AA. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall
- 2 mean "as-built" systems, subsystems, equipment, and components.
- 3 BB. Startup: The initial starting or activating of dynamic equipment, including executing prefunctional checklists.
- 4 CC. Subs: The subcontractors to the GC who provide and install building components and systems.
- 5 DD. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test
- 6 procedures are developed by the CxP.
- 7 EE. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test
- 8 requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents
- 9 FF. Trending: Monitoring using the building control system.
- 10 GG. Vendor: Supplier of equipment.
- 11 HH. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at
- 12 Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract
- 13 Documents and accepted submittals.

14 1.4 DESCRIPTION

- 15 A. This Section includes exterior enclosure commissioning procedures, including substructure, superstructure,
- 16 exterior enclosure, and roofing construction that protects climate controlled interior space from unconditioned
- 17 spaces and the exterior environment.
- 18 B. Commissioning:
 - 19 1. A systematic process ensuring that all building enclosure systems perform interactively according
 - 20 to the Architect's BoD and the OPR. This is to be achieved through actual verification of systems
 - 21 performance during the construction period.
 - 22 2. The commissioning process does not take away from, or reduce the responsibility of, the General
 - 23 Contractor, General Contractor, and installing subcontractors to provide a finished and fully
 - 24 functioning product.
 - 25 3. Whole building commissioning includes both MEP commissioning and building enclosure
 - 26 commissioning. This specification only addresses building enclosure commissioning.
- 27 C. The Commissioning Provider(CxP) has no authority to change, modify or direct any work. The CxP can only
- 28 provide comments and suggestions.
- 29 D. Commissioning Plan: The Cx Plan provides guidance in the execution of the Cx process. The CxP will update the
- 30 Cx Plan regularly as the project progresses. The Drawings and Specifications will take precedence over the Cx
- 31 Plan.
- 32 E. Commissioning Team: The members of the commissioning team consist of the Commissioning Provider (CxP),
- 33 the Owner's Representative (OR), the designated representative of the owner's Construction Management firm
- 34 (CM), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical
- 35 engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls
- 36 Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or
- 37 plant operator/engineer is also a member of the commissioning team.
- 38 F. Management: The CxP is hired by the Owner directly. The CxP directs and coordinates the commissioning
- 39 activities and the reports to the OR. All members work together to fulfill their contracted responsibilities and
- 40 meet the objectives of the Contract Documents.
- 41 G. Scheduling: The CxP will work with the CM and GC according to established protocols to schedule the
- 42 commissioning activities. The CxP will provide sufficient notice to the CM and GC for scheduling commissioning
- 43 activities. The GC will integrate all commissioning activities into the master schedule. All parties will address
- 44 scheduling problems and make necessary notifications in a timely manner in order to expedite the
- 45 commissioning process.
- 46 H. The CxP will provide the initial schedule of primary commissioning events at the commissioning scoping meeting.
- 47 The Commissioning Plan provides a format for this schedule. As construction progresses, more detailed
- 48 schedules are developed by the CxP. The Commissioning Plan also provides a format for detailed schedules.

49 1.5. SUBMITTALS

- 50 A. Certificates of readiness
- 51 B. Certificates of completion, completed checklists, and test results for installation, prestart, and startup activities.

52 1.5 ALLOWANCES

- 53 A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing
- 54 are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

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1.5 RESPONSIBILITIES

A. Owner

1. Provide the OPR documentation to the CxP and Contractor for information and use.
2. Identify areas and components of the building enclosure in scope for enclosure testing
3. Hire third-party enclosure testing consultant to conduct initial testing and (1) retest in the event of test failure.
4. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
5. Provide the BOD documentation, prepared by Architect and approved by Owner, to the CxP and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
6. Follow the Commissioning Plan.
7. Attend commissioning scoping meetings and additional meetings as necessary.

B. Architect/Engineer (AE)

1. The AE shall participate in and perform commissioning process activities including, but not limited to, the following:
 - a. Provide paper and electronic copies of Project Drawings and specifications to the CxA.
 - b. Attend the commissioning scoping meeting and selected commissioning team meetings.
 - c. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
 - d. Provide any design narrative and sequence documentation requested by the CxP. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 - e. Participate in testing/inspection procedures meetings.
 - f. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
 - g. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
 - h. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.
 - i. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

C. General Contractor (GC)

1. General Contractor or General Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 - a. Provide Coordination Drawings (see Section 1.6 Building Enclosure Coordination Documents) showing the complete coordination and integration of all work of commissioned envelope systems to the Commissioning Provider.
 - b. Provide cut sheets and Shop Drawings Submittals of commissioned systems to the Commissioning Provider.
 - c. Attend Preconstruction, Design, and Construction Phase building enclosure coordination meetings.
 - d. Provide Test Data, Letters of Compatibility, and Certificates to the Commissioning Authority.
 - e. Coordinate trades in accordance with the requirements in the General Conditions and General Requirements of the Construction Contract.
 - f. Permit and provide access to locations of installed systems, subsystems, and components for testing and inspection
 - g. Review test procedures to ensure feasibility, safety and equipment protection and provide necessary written limits to be used during tests.
 - h. Provide schedule and accommodate field quality control tests and inspections required by the
 - i. Contract Documents and product manufacturers to the Commissioning Provider.
 - j. Upgrade schedule biweekly throughout the construction period.

- 1 k. Facilitate owner-provided field quality control testing and inspections on exterior
- 2 enclosure construction (including filling out commissioning checklists) and submit reports
- 3 to the Commissioning Agent.
- 4 l. Participate in testing/inspection procedures meetings.
- 5 m. Direct appropriate subcontractors to correct deficiencies as interpreted by the
- 6 Commissioning Provider, Designer, and Owner.
- 7 n. During construction, maintain as-built redline drawings for all drawings.
- 8 o. Coordinate with manufacturers to determine specific requirements to maintain the validity
- 9 of the warranty.
- 10 p. Provide input for final commissioning documentation to the Commissioning Provider.
- 11 q. Submit operation and maintenance data for systems, subsystems, and components to the
- 12 Commissioning Provider
- 13 r. Participate in maintenance orientation, training, and inspection.
- 14 D. Subcontractors
- 15 1. Contractor shall assign representatives with expertise and authority to act on its behalf and shall
- 16 schedule them to participate in and perform commissioning process activities including, but not
- 17 limited to, the following:
- 18 a. Provide all requested submittal data, including detailed start-up procedures and specific
- 19 responsibilities of the Owner to keep warranties in force.
- 20 b. Assist in equipment testing per agreements with Prime.
- 21 c. Include all special tools and instruments (only available from vendor, specific to a piece of
- 22 equipment) required for testing equipment according to these Contract Documents in the
- 23 base bid price to the Contractor, except for stand-alone data logging equipment that may
- 24 be used by the CxP.
- 25 d. Provide information requested by CxP regarding equipment sequence of operation and
- 26 testing procedures.
- 27 e. Review test procedures for equipment installed by factory representatives.
- 28 f. Complete paper or electronic construction checklists as work is completed and provide to
- 29 the CxP.
- 30 g. Follow the Commissioning Plan
- 31 h. Attend commissioning scoping meetings and additional meetings as necessary.
- 32 E. Commissioning Provider (CxP)
- 33 2. The CxP is not responsible for design concept, design criteria, compliance with codes, design or
- 34 general construction scheduling, cost estimating, or construction management. The CxP may
- 35 assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility
- 36 resides with the general contractor and the A/E. The primary role of the CxP is to develop and
- 37 coordinate the execution of a testing plan, observe and document performance—that systems are
- 38 functioning in accordance with the documented design intent and in accordance with the
- 39 Contract Documents. The Contractors will provide all tools to start, check-out and functionally
- 40 test building enclosure systems. Specific tasks of the CxP include the following:
- 41 a. Coordinate and direct the commissioning activities using consistent protocols and forms,
- 42 centralized documentation, clear and regular communications and consultations with all
- 43 necessary parties, frequently updated timelines and schedules and technical expertise.
- 44 b. Incorporate commissioning requirements into the Construction Documents via a
- 45 commissioning specification.
- 46 c. Initial review of preliminary Construction Documents against OPR and BOD.
- 47 d. Perform back check review of Construction Documents against OPR and BOD.
- 48 e. Develop functional Test Plan for exterior enclosure.
- 49 f. Review of Project Drawings and Specifications at 50%, and 100% completion for
- 50 constructability, durability, and performance of exterior enclosure conformance.
- 51 g. Review of pertinent building enclosure Shop Drawings/Submittals for compliance with
- 52 procedures for spray rack testing equipment, and instructions for construction of test
- 53 chambers.
- 54 h. Observe the construction and testing of mockups (if applicable).
- 55 i. Document construction of commissioned components at the completion of mockup
- 56 testing. This documentation will consist of graphic representation of mockup details for
- 57 use in revising shop drawings as needed (if applicable).
- 58 j. Attend pertinent Progress Meetings (as needed).

- 1 k. Perform field observations of exterior enclosure installations.
- 2 l. Maintain a log of deficient conditions.
- 3 m. Observe functional field performance (in-situ) testing.
- 4 n. Evaluate substitution requests for compliance with Contract Documents and for
- 5 compatibility with work of other subcontractors.
- 6 o. Compile test data, inspection reports, and certificates and include them in the Systems
- 7 Manual and Commissioning Process Report.
- 8 p. Resolve conflicts in the installation of materials and assemblies specific to the building
- 9 enclosure trades.
- 10 q. Finalize Commissioning Record with warranties and closeout documentation.
- 11 r. Verify applicable training procedures of building maintenance personnel.
- 12

13 1.6 BUILDING ENCLOSURE COORDINATION DOCUMENTS

- 14 A. The CM/GC shall be fully responsible for coordinating all trades, assuring proper construction sequences and
- 15 schedules, and coordinating the actual installed location and interface of all work that impacts the building
- 16 enclosure. Before materials are fabricated or the work begun, the CM/GC shall supervise and direct the
- 17 creation of one set of Coordination Drawings showing the complete coordination and integration of all work of
- 18 this Project relating to the thermal, drainage, air barrier, vapor barrier, and waterproofing systems of
- 19 enclosure. Coordination Drawings are intended to assist the CM/GC during construction, and may be
- 20 produced using Architect's drawings, shop drawings, or other drawings as needed to communicate
- 21 coordination requirements to all concerned subcontractors. Specifically, Coordination Drawings shall include,
- 22 but are not limited to the following detail conditions and system connections:
- 23
 - 24 1. Precast wall panel joints
 - 25 2. Roof-to-wall metal flashing terminations
 - 26 3. Roof-to-wall flashing conditions at all locations
 - 27 4. Precast concrete panel tie-in to adjacent waterproofing/air barrier membranes
 - 28 5. Roofing system penetrations
 - 29 6. Flashing at fenestrations and doors.

30 PART 2 – PRODUCTS (NOT USED)

31 PART 3 - EXECUTION

32 3.1 FUNCTIONAL PERFORMANCE TESTING (IN-SITU)

- 35 A. Objectives and Scope: The objective of functional performance testing is to demonstrate that selected building
- 36 enclosure/assembly systems, as identified by the Owner in consultation with the BECx, are operating
- 37 according to the documented design intent of the Contract Documents and in accordance with the OPR.
- 38 Functional testing facilitates bringing the material assembly from a state of substantial completion to full
- 39 operation. Additionally, during the testing process, areas of non-compliant performance are identified and
- 40 corrected, improving the operation and functioning of the building enclosure/assemblies.
- 41 B. Development of Test Procedures: Before test procedures are written, the CxP shall obtain all requested
- 42 documentation and a current list of change orders affecting building enclosure/assemblies. The CxP shall
- 43 develop specific test procedures for each building enclosure/assembly. Prior to execution, the CxP shall
- 44 provide a copy of the test procedures to the subcontractor(s) who will review the tests for feasibility, building
- 45 enclosure/assemblies warranty protection.
- 46
 - 47 1. The CxP shall observe GC-contracted performance testing.
 - 48 2. The GC shall construct or arrange for construction of test chambers and shall provide staging and
 - 49 access equipment as needed to position spray racks at the exterior.
 - 50 3. The purpose of any given specific test is to verify and document compliance with the stated
 - 51 criteria of the Construction Documents.
- 52 C. Test methods
- 53
 - 54 1. Functional performance testing and verification will typically follow ASTM industry standards. The
 - 55 owner, in consultation with the CxP, will determine which method is most appropriate for tests
 - 56 and modify test methods when an existing industry method is not available or applicable.
 - 57 2. Simulated Conditions: Simulating conditions may be allowed at the direction of the CxP, though
 - 58 testing actual conditions is encouraged wherever practical.
- D. Coordination and Scheduling: The General Contractor and their subcontractors shall provide sufficient notice
- to the Commissioning Authority regarding their completion schedule for the functional checklists and

1 construction of the assemblies or building enclosure systems. The General Contractor will schedule functional
2 tests with the CxP and affected subcontractors. All functional testing of all building enclosure assemblies or
3 building enclosure systems shall be performed by a third party.

- 4 E. In general, functional testing is conducted after mockup testing has been satisfactorily completed.
5 F. Problem Solving: The CxP may recommend solutions to problems found, however, the burden of responsibility
6 to solve, correct, and retest problems is with the contractor responsible for the installation of the tested
7 assembly.
8 G. Failed tests will typically result in additional testing of the failed specimen. The cost of re- staging and
9 constructing test chamber shall be responsibility of the deficient contractor. The cost for the testing agency
10 to conduct initial testing and one (1) retest of the failed specimen will be borne by the Owner. Costs for
11 subsequent retests due to failure shall be the responsibility of the deficient contractor. Test will be concluded
12 only when satisfactory results are achieved.

13 H. Non-Conformance:

- 14 1. The CxP will record the results of the functional tests in a written report. All deficiencies or non-
15 conformance issues shall be noted and reported.
16 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the
17 CxP. In such cases, the deficiency and resolution will be documented in the written report.
18 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while
19 not compromising the integrity of the procedures.
20 4. As tests progress and a deficiency is identified, the CxP discusses the issue with the executing
21 Contractor.
22 a. The CxP documents the deficiency and the subcontractor's response and intentions and
23 work proceeds.
24 b. The CxP will coordinate the rescheduled test with the affected Contractor, and the test is
25 repeated.
26 5. As tests progress and a deficiency is identified, the CxP discusses the issue with the executing
27 Contractor.
28 a. The CxP documents the deficiency and the subcontractor's response and intentions and
29 work proceeds.
30 b. The CxP will coordinate the rescheduled test with the affected Contractor, and the test is
31 repeated.
32 6. If there is a dispute about a deficiency regarding whether it is a deficiency or who is responsible:
33 a. The deficiency shall be documented on the Non-Compliance Form with the subcontractor's
34 response and copy give to the General Contractor and to the subcontractor's
35 representative assumed to be responsible.
36 b. Resolutions are made at the lowest management level possible. Other parties are brought
37 into the discussions as needed. Interpretive authority is with the A/E. Final acceptance
38 authority is with the OR.
39 c. The CxP documents the resolution process.
40 d. Once the interpretation and resolution have been decided, the appropriate party corrects
41 the deficiency, signs the Statement of Correction on the Non- Compliance form, and
42 provides it to the CxP. The General Contractor shall reschedule the test with the affected
43 Contractors, and the test(s) are repeated until satisfactory performance is achieved.
44 e. Any required retesting that is a result of deficient installation shall not be considered a
45 justified reason for a claim of delay or for a time extension by the Contractor.
46 f. Work associated with any envelope system or component that fails testing will
47 immediately cease until testing non-conformances/failures are corrected, and re-testing
48 proves successful.
49
50

END OF SECTION

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**SECTION 02 20 00
GENERAL SITEWORK REQUIREMENTS**

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide the work on the site as provided for in the technical specifications and on the drawings.
- B. All work on public facilities or on public lands and/or public rights of way shall conform to the applicable City of Madison's Construction Standards stated below.
- C. All work shall be in accordance with applicable manufacturer's instructions.

1.2 RELATED WORK AND PROVISIONS

- A. This section relates to all Division 2 sections as they pertain to "sitework" to be performed.
- B. This specification shall apply to all site work unless otherwise specified.
- C. Applicable provisions of Division 1 shall govern all work under Division 2 and all Division 2 specifications.

1.3 REFERENCE STANDARDS

- A. Abbreviations of standards or organizations referenced in this specification are as follows:

AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ACPA	American Concrete Pipe Association
AGA	American Gas Association
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASME	American Society of Mechanical Engineers
ASPE	American society of Plumbing Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
CISPI	Cast Iron Soil Pipe Institute
CS	Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS
EPA	Environmental Protection Agency
FS	Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
IAPMO	International Association of Plumbing & Mechanical Officials
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
PDI	Plumbing and Drainage Institute
STI	Steel Tank Institute
UL	Underwriters Laboratories Inc.
- B. Where reference is made to the "Construction Standards", it shall be construed to mean the pertinent section of the City of Madison's Construction Standards.

1.4 SUBSTITUTIONS

- A. Substitution of Materials: Refer to the General Conditions of the Contract.
- B. Where equipment, accessories, or materials are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated in the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

1 **1.5 CONTINUITY OF EXISTING TRAFFIC, PARKING, AND UTILITIES**

- 2 A. Refer also to Division 1 - Contract General Requirements.
- 3 B. Do not interrupt or change existing traffic, delivery, parking, or utility services without prior written approval
- 4 from the Construction Representative. When interruption is required, coordinate schedule with the Owner
- 5 agency to minimize disruptions. Unless specifically stated, all work involved in interrupting or changing existing
- 6 services is to be done during normal working hours.
- 7 C. Verify the locations of any water, drainage, gas, sewer, electric, drainage, gas, sewer, electric, telephone, fuel,
- 8 steam lines or other utilities, and site features which may be encountered in any excavations or other sitework.
- 9 All lines shall be properly underpinned and supported to avoid disruption of service. Any service connections
- 10 encountered which are to be removed shall be cut off at the limits of the excavation and capped in accordance
- 11 with the requirements of permits governing such removals. Any permits required for this work will be obtained
- 12 by the Owner upon request of the Contractor.
- 13 D. The Contractor shall comply with Wisconsin Statutes 62.15(11) Street Obstructions specifically that doing any
- 14 work which shall in any manner obstruct the streets or sidewalks shall put up and maintain barriers conforming
- 15 to the standards for traffic control devices in the manual adopted by the Department of Transportation under
- 16 s. 84.02 (4) (e) to prevent accidents, and be liable for all damages caused by failure so to do. All contracts shall
- 17 contain a provision covering this liability, and also a provision making the contractor liable for all damages
- 18 caused by the negligent digging up of streets, alleys or public grounds, or which may result from the Contractor's
- 19 carelessness in the prosecution of such work.
- 20

21 **1.6 PROTECTION OF EXISTING WORK AND FACILITIES**

- 22 A. Verify the locations of, and protect, any signs, paved surfaces, buildings, structures, landscaping, streetlights,
- 23 utilities, and all other such facilities that may be encountered or interfered with during the progress of the work.
- 24 Take all measures necessary to safeguard all existing work and facilities which are outside the limits of the work
- 25 or items which are within the construction limits but are intended to remain.
- 26 B. Protect all paved, turfed, and landscaped surfaces to remain. Protect all areas outside of the construction limits
- 27 from the effects of erosion in accordance with the Erosion Control specification section.
- 28

29 **1.7 CONSTRUCTION LIMITS**

- 30 A. Construction Limits are indicated on the drawings. In the absence of such a designation on the drawings,
- 31 confine work to the minimum area reasonably necessary to undertake the work as determined by the Engineer.
- 32 All areas disturbed by excavation and grading, plus such additional areas as are disturbed by construction related
- 33 activities including construction access and storage and installation of materials shall be considered the
- 34 "Construction Area".
- 35

36 **1.8 EQUIPMENT AND MATERIALS FURNISHED BY OTHERS**

- 37 A. None.
- 38

39 **1.9 SUBMITTALS**

- 40 A. Refer also to Division 1 - Contract General Requirements.
- 41 B. Submit manufacturer's preproduction (shop) drawings for any off-site constructed sitework items for approval
- 42 prior to the start of manufacturing and any electrically powered equipment.
- 43

44 **1.10 CERTIFICATIONS AND INSPECTIONS**

- 45 A. Refer also to Division 1 - Contract General Conditions.
- 46 B. Obtain and pay for all required sampling, testing, inspections, and certifications except those provided by the
- 47 Architect/Engineer (A/E). Deliver originals of certificates and documents to the Owner's Project Representative.
- 48 Include copies of the certifications and documents in the Operating and Maintenance instructions.
- 49

50 **1.11 OPERATING AND MAINTENANCE INSTRUCTIONS**

- 51 A. Refer also to Division 1 - Contract General Requirements.
- 52 B. Assemble material in an operating and maintenance manual composed of three-ring or post binders, using and
- 53 index at the front of each volume and tabs for each system or type of equipment installed. In addition to the
- 54 data indicated in the General Requirements, include the following information:
- 55 1. Copies of all approved shop drawings
- 56 2. Manufacturer's wiring diagrams for electrically powered equipment
- 57 3. Records of tests performed to certify compliance with system requirements
- 58 4. Certificates of inspection by regulatory agencies

- 1 5. Parts lists for manufactured equipment
- 2 6. Lubrication instructions, including lists of frequency of lubrication during construction
- 3 7. Warranties and/or guarantees
- 4 8. Additional information as indicated in the technical specification sections
- 5

6 **1.12 TRAINING OF OWNER PERSONNEL**

- 7 A. Instruct Owner personnel or their designee in the proper operation and maintenance of systems and equipment
- 8 provided as part of this project.
- 9

10 **1.13 RECORD DRAWINGS**

- 11 A. Refer also to Division 1 - Contract General Requirements.
- 12 B. Include copies of record drawings with the Operating and Maintenance instructions.
- 13

14 **PART 2 - PRODUCTS**

15

16 **2.1 TRAFFIC CONTROL - BARRICADES, SIGNS, AND WARNING DEVICES**

- 17 A. Provide traffic barricades, traffic signs, and warning devices in accordance with governing codes and regulations
- 18 and the Manual of Uniform Traffic Control Devices (MUTCD).
- 19 B. Provide excavation barrier fencing in plastic, blaze orange color together with all supports and braces necessary
- 20 to provide an adequate safety barrier to unattended excavations.
- 21

22 **2.2 WARNING SIGNS**

- 23 A. Provide all necessary warning signing as required by OSHA, these specifications, as directed by the City of
- 24 Madison's Construction Representative and as shown on the drawings. Payment for providing, placing,
- 25 maintaining, and removing traffic control devices will be paid under the traffic control bid item as a lump sum
- 26 item for all project areas.
- 27

28 **PART 3 - EXECUTION**

29

30 **3.1 PROJECT SITE CONDITIONS**

- 31 A. Maintain a clean, safe, and orderly site.
- 32 B. Provide adequate barricades, guards, warning lights, and other protection required at excavation and hazards
- 33 created by work.
- 34 C. Control access to the site by only authorized personnel and vehicles.
- 35 D. Maintain site housekeeping to provide for a safe and orderly project site. Collect and dispose of debris as it
- 36 accumulates.
- 37 E. Provide shoring, bracing, sheet piling, planking, and forming required by the work.
- 38 F. Locate and protect overhead and underground utilities, sidewalks, drains, curbs, trees (including roots) shrubs,
- 39 ground cover, bench marks, monuments, other reference points, adjacent buildings, materials, and property
- 40 owned by others that are to remain.
- 41 G. Protect items, bearing responsibility for and replacement cost of damage arising from all operations connected
- 42 with the work. If items are disturbed or destroyed, replace as directed by the Owner's representative.
- 43 H. Fence and/or box in all trees and plant material which are to remain at the drip line before work is started. Do
- 44 not permit heavy equipment or stockpiles within branch spread. Remove interfering branches without injury to
- 45 trunks and cover scars with tree paint.
- 46 I. Control grading around structures; pitch ground to prevent water running into excavated areas.
- 47 J. Pits, trenches within building lines, and other excavations shall be maintained free of water.
- 48 K. Provide trenching, pumping, and other facilities required.
- 49 L. Notify City and Owner's Project Representatives if springs or running water are encountered in excavation;
- 50 provide discharge by trenches and drains pumping to point outside of excavation. Provide information to
- 51 Owner's Project Representative of points and areas that water will be discharged. Control discharge with
- 52 methods acceptable to Wisconsin Department of Natural Resources (WDNR), the City's Project Representative
- 53 and Local Municipal Regulations. At the Engineer's option, the Contractor shall drain the spring to the storm
- 54 sewer system by the use of field tile.
- 55 M. Be responsible for control measures to prevent damage from flooding, erosion, and sedimentation to on-site
- 56 and off-site areas.

1 N. Install and maintain temporary desilting basins, terraces, contour furrows, channel linings, waterways, and other
2 measures as shown on plan and as described in the WPDES and City of Madison permits obtained for the project
3 to prevent damage.
4

5 **3.2 WATER (DUST CONTROL)**

6 A. Contractor shall apply water to the subgrade as directed by the City of Madison’s Construction Representative
7 for dust control. Water shall be provided by the contractor and placed in accordance with Section 624 of the
8 State Specifications. Water for base compaction shall be incidental to the base aggregate items and will not be
9 paid under this item.
10

11 **3.3 SITE RESTORATION**

12 A. Unless otherwise specified or noted on the drawings, fully and completely restore the site to a condition present
13 prior to the work. Restore the surface of all disturbed areas to a like condition of the surface prior to the work.
14 Sawcut and remove all damaged pavements to the nearest existing joints, or with prior permission, to straight
15 and neat lines and repair with like materials to the full depth of the pavement as existed prior to the work.
16 B. See applicable Sections for specific restoration requirements.
17

18 **3.4 CLEAN UP**

19 A. Level off/shape all waste disposal areas and clean up areas used for the storage of materials or the temporary
20 deposit of excavated earth. Remove all surplus material, tools and equipment.
21 B. Burning is not permitted.
22 C. Thoroughly clean all sewers and structures and remove and dispose of all debris and mud.
23
24

END OF SECTION

**SECTION 02 32 00
GEOTECHNICAL INVESTIGATION**

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section shall consist of providing all work, materials, labor, section provides information resulting from subsurface investigations completed at the site as part of this project. This section may contain information applicable to ALL sitework, and other technical specification sections, as well. All contractors are expected to review this information as part of their duties to familiarize themselves with the site.
- B. Results of the geotechnical investigation apply only to the locations at which data was collected, at the specific time it was collected. Geotechnical conditions may differ elsewhere on the site.
- C. Geotechnical Engineering Services Report for former FedEx Home Delivery Facility (3829 Hanson Road) prepared for Ruedebush Development & Construction, 4605 Dovetail Drive, Madison, WI 53704 (prepared by CGC Inc., dated May 3, 2012). Additional geotechnical data was gathered during the building expansion construction at 3901 Hanson Drive for the former FedEx Building prepared for Ruedebush Development & Construction, 4605 Dovetail Drive, Madison, WI 53704 (prepared by CGC Inc., dated March 26, 2009).
- D. Prior to making additional investigations of his own using test pits, borings, or other methods; Bidder shall first gain permission from property owner and Owner's Project Manager.
- E. Geotechnical investigations completed by Bidder shall comply with all applicable requirements of Division 1 through Division 16 of this project.

1.2 RELATED WORK

- A. Applicable provisions of Division 01 govern work under this Section.
 - 1. Section 31 05 00 - Common Work Results for Earthwork
 - 2. Section 31 20 00 - Earthmoving
 - 3. Section 31 22 16.15 - Subgrade Preparation
 - 4. Section 32 11 23 - Aggregate Base Course
 - 5. Section 32 17 23 - Pavement Markings

PART 2 - PRODUCTS

2.1 REPORTS

- A. The Geotechnical Investigation Report at the end of this section is included for the Contractor's information.
- B. This report is also available by contacting the Geotechnical Consultant:
 - 1. CGC, Inc., 608-288-4100, CGC Report No's. C13061 and C09046.

PART 3 - EXECUTION

Not used.

END OF SECTION



Construction • Geotechnical
Consulting Engineering/Testing

May 3, 2013
C13061

Mr. David Nelsen, P.E.
Ruedebusch Development & Construction
4605 Dovetail Drive
Madison, WI 53704

Re: Geotechnical Exploration Report
FedEx Home Delivery Facility
Hanson Road
Madison, Wisconsin

Dear Mr. Nelsen:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration program for the proposed expansion of the FedEx Distribution Center on Hanson Road in Madison, Wisconsin. The primary purpose of the exploration program was to evaluate the subsurface conditions on the site and to provide geotechnical recommendations regarding site preparation, foundation, floor slab and pavement design/construction. One copy of this report is provided for your use, and additional copies can be provided upon request.

PROJECT DESCRIPTION

We understand the proposed home delivery facility will expand the existing distribution center. The new facility will be a separate slab-on-grade steel frame pre-engineered building approximately 69,000 sq ft in size. Finish floor is proposed at EL 41.33 (Madison City datum). As a result, the majority of the building area will require filling from about 1 to 13.5 ft, while the remainder, mostly in the northeast corner, will require up to about 5.5 ft of cutting. Loading dock walls will be constructed along the west side of the building.

Parking and access drives for car and truck traffic will be developed on the north, west and south sides of the building, with an additional larger parking area to the north of the building. Truck and automobile traffic is initially projected to be about 160 and 180 vehicles per day, respectively. The total estimated equivalent 18-kip single axle loads (ESALs) over a 10-year pavement life are just below 300,000.

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SITE CONDITIONS

The site is located to the west of the existing FedEx distribution center on the south side of Hanson Road in the City of Madison. Site topography generally slopes down to the south and west, with multiple soil stockpiles remaining on the south side of the parcel due to prior site grading/stockpiling. At the time of drilling the north half of the site was a tilled agriculture field.

SUBSURFACE EXPLORATION

The subsurface conditions in the area of the proposed building were explored by drilling four Standard Penetration Test (SPT) soil borings to a depth of 20 ft in locations selected by your firm and staked in the field by the drillers. The soil borings were performed by Badger State Drilling (under subcontract to CGC) on March 20, 2013 using an ATV-mounted CME 750 drill rig equipped with hollow stem augers. Appendix A presents additional field exploration details. The boring locations are shown in plan on the soil boring location map presented in Appendix B. Ground surface elevations at the boring locations were interpolated from the topographic map you provided to us, and verified during surveying by CGC personnel shortly after drilling. The elevations are referenced to Madison City datum and should be considered approximate.

The recent borings supplement previous borings performed by CGC in July of 2003 for the development of the existing FedEx building to the east of the proposed structure. The logs for the previous borings are included in Appendix B but do not reflect any grading (cutting or filling) that may have occurred since their completion. Other borings performed in 2003 to the east of the proposed building are not included but can be provided upon request.

The subsurface profile at the boring locations is fairly similar and can generally be described by the following strata (in descending order):

- 12 in. of *topsoil*; over
- 2.5 to 4.5 ft of very stiff to hard *lean clay*; underlain by
- Loose to dense *sand* strata to the maximum depths explored.

As exceptions to the typical profile, the lean clay layer was absent in Borings 2 and 4, and about 10 ft of *fill/probable fill* involving sand and gravel was encountered over the sand strata in Boring 4, probably due to prior site grading and stockpiling.

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Groundwater was not encountered during or shortly after drilling. Groundwater levels are expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration and other factors. Additional details on the site soil and groundwater conditions are presented on the boring logs attached in Appendix B.

Note that the soil profile in the three borings conducted during the previous exploration follow the same general profile, and as noted above are included in Appendix B.

DISCUSSION AND RECOMMENDATIONS

Based on the findings from the exploration program and subject to the limitations discussed in the report, it is our opinion that the site is suitable for construction and that the structure can be supported by conventional shallow foundations. Our recommendations for site preparation, as well as foundation, floor slab, and pavement design/construction are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

1. Site Preparation

To prepare the site for construction, we recommend that the vegetation and surficial topsoil/stockpiled material be stripped/removed to a minimum of 5 to 10 ft beyond the proposed building and pavement areas. The topsoil can be stockpiled for later use in landscaped areas or hauled off site, while the stockpiled granular (sand and/or gravel) material may potentially be used for building pad fill. The exposed subgrades are expected to consist primarily of very stiff to hard lean clay or loose to medium dense sand soils. The exposed areas to receive fill should first be proof-rolled with a large, rubber-tired piece of construction equipment (i.e., loaded dump truck, scraper or front-end loader). If soft/yielding areas are detected they should be selectively undercut/removed, and they should be stabilized using breaker run stone (nominal 3 in. maximum size with less than 10% passing the No. 200 sieve) compacted into the subgrade until little (if any) deflection is noted.

To supplement sand fill available on the site, imported granular soils (i.e., sand and/or gravel) are recommended for use as fill material because they are easier to place and compact in most weather conditions, compared to clay/silt soils. Fill should be placed and compacted in accordance with our recommended compacted fill specifications attached in Appendix D. Fill material placed within the building pad should be placed and compacted to a minimum of 95% of maximum dry density based on modified Proctor methods (ASTM D1557). Periodic field density tests taken by CGC staff within the fill are recommended to document the adequacy of the compactive effort.

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2. Foundation Design

It is our opinion that the proposed structures can be supported on conventional shallow spread foundations bearing on either native or granular or cohesive material, as well as granular fill material placed and compacted to a minimum of 95% of maximum dry density based on modified Proctor methods (ASTM D1557).

Provided footing subgrades are prepared in accordance with the preceding recommendations, the following parameters should be used for foundation design:

- Maximum allowable bearing pressure: 3,500 psf
- Minimum foundation widths:
 - Continuous wall footings: 18 in.
 - Column footings: 30 in.
- Minimum depths for footings requiring frost protection: 4 ft

Undercutting will be required if natural clays with pocket penetrometer readings (an estimate of the unconfined compressive strength of cohesive soils) of less than 1.75 ton/sq ft or looser granular soils are observed at or below footing grade. Particular attention should be paid to the northeastern position of the site where site grades will be cut and loose zones may exist in the native sands at footing grade. Where undercutting is required, the base of the undercut excavations should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes. Grade can be restored using compacted coarse stone (breaker run, select crushed material or 3-in. dense graded base course, as described in Appendix D). CGC should be present during footing excavations to check that adequate soil conditions exist or recommend corrective measures, if necessary.

We recommend using a smooth-edged backhoe bucket for footing excavations. Further, native and granular fill footing subgrade soils should be rigorously compacted with a large vibratory plate compactor or hoe-pak (backhoe mounted compactor) and clay soils should be recompacted with a jumping jack (or hand-trimmed) to density soils loosened/disturbed during excavation. Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should not exceed 1.0 and 0.5 in., respectively.

3. Floor Slabs

In our opinion, the slab-on-grade can be supported on either native or compacted granular (sand and/or gravel) fill soils and may be designed using a subgrade modulus of 100 pci. Prior to slab

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construction, the subgrade should be recompacted to densify soils that may become disturbed or loosened during construction activities. The design subgrade modulus is based on a recompacted subgrade such that non-yielding conditions are developed. To serve as a capillary break, the final 4 in. of soil placed below the floor slab should consist of an imported well-graded sand or gravel (with a maximum particle size of less than 3 in. with no more than 5 percent by weight passing the No. 200 U.S. standard sieve). To further minimize the potential for moisture migration, a plastic vapor barrier could also be utilized. Fill material below the floor slab should be placed as described in the Site Preparation section of this report.

The slab should be structurally separate from the foundations and have construction joints and reinforcement for crack control.

4. Loading Dock Walls

We anticipate that loading dock walls will be laterally restrained by the slab-on-grade. Therefore, *at-rest lateral earth pressures* should be used during design. To minimize the development of such pressures, granular backfill should be placed within 4 to 6 ft of the walls.

Walls constructed in accordance with the above recommendations may be designed for an equivalent fluid pressure of 55 psf per foot of depth. The below grade wall design should also take into account surcharge loads which could be applied during or after construction.

5. Pavement Design

We assume that the main parking lot and circulation roadway pavement will be exposed to significant truck traffic (i.e., a medium to heavy traffic class). The employee and visitor parking lot, on the other hand, will receive mostly car or light truck traffic with minimal heavy truck traffic. Provided the parking lot fills will be developed as described above, we anticipate that the pavement thickness design will be controlled by the lean clay soil subgrade elevation below portions of the site. Prior to placing base course, the subgrade soils should be proof-rolled as discussed in the Site Preparation section of this report. Anticipating that some soft/loose zones may be found during proof-rolling, we recommend that a contingency be included in the project budget to account for an estimated 20% of the pavement area requiring undercutting and replacement with 12 in. of coarse stone. The pavement section tabulated below was selected assuming a CBR value for clay soils of approximately 5 and a design life of 10 years.

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**TABLE 1
 RECOMMENDED FLEXIBLE PAVEMENT SECTIONS
 (10-Year Pavement Life)**

Material	Thickness (in.)		WisDOT Specification ¹
	Heavy Duty: Truck Parking and Drives	Light Duty: Car Parking Lot	
Bituminous upper layer (surface course)	1.75	1.5	Section 460, Table 460-1, 12.5 mm
Bituminous lower layer (binder course)	2.25	1.5	Section 460, Table 460-1, 19.0 mm
Dense Graded Base (Crushed aggregate base course)	12.0	8.0	Section 301 and 305, 75 mm and 31.5 mm
TOTAL THICKNESS	16.0	11.0	

Notes:

1. Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, with supplementals.
2. Compaction requirements:
 - Bituminous concrete: Refer to Section 407, WisDOT *Standard Specification for Highway and Structure Construction*.
 - Base course: 95% modified Proctor (ASTM D1557).
3. Type E-1 hot mix asphalt is recommended.

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4. To accommodate a total of 600,000 ESALS (approximately a 20-yr design life), the asphalt thickness can be increased to 4.5 in. (total) OR a layer of heavy-duty woven geotextile (Mirafi 600X or equivalent) can be installed below the base course.

The pavement design assumes a stable non-yielding subgrade and a regular program of preventative maintenance. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompact.

Pavement areas subjected to concentrated wheel loads (e.g., loading dock slabs, trailer wheel pads, dumpster pads, etc.) should be constructed of Portland cement concrete. The slab should be a minimum of 6-in. thick and should contain mesh reinforcement for crack control. If the truck drives are constructed as rigid (PC concrete) pavements, a subgrade modulus of 100 pci can be used for design, provided a non-yielding subgrade exists as discussed previously. A minimum of 6 in. of granular base course should be placed and compacted below the concrete slab.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil-related difficulties which could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of the on-site soils, we recommend the final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.
- Earthwork construction during the early spring or late fall could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.
- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.
- Based on anticipated excavation depths, groundwater infiltration into excavations for the building is not expected to be a concern. However, water accumulating at the base of building excavations as a result of precipitation or seepage (if any) should be removed using pumps operating from filtered sump pits.



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RECOMMENDED CONSTRUCTION MONITORING

The quality of the foundation, floor slab and pavement subgrades will be largely be determined by the level of care exercised during site development. To check that earthwork and foundation construction proceeds in accordance with our recommendations, the following operations should be monitored by CGC:

- Topsoil stripping/subgrade proof-rolling within the construction areas;
- Fill/backfill placement and compaction;
- Foundation excavation and subgrade preparation; and
- Concrete placement

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

Alex J. Bina, E.I.T
Staff Engineer

William W. Wuellner, P.E.
Senior Geotechnical Engineer

- Encl: Appendix A - Field Investigation
Appendix B - Soil Boring Location Map
Logs of Test Borings (4)
Logs of Previous Test Borings (3)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD INVESTIGATION

The subsurface conditions in the area of the proposed building were explored by drilling four Standard Penetration Test (SPT) soil borings to a depth of 20 ft in locations selected by your firm and staked in the field by CGC personnel. The soil borings were performed by Badger State Drilling (under subcontract to CGC) on March 20, 2013 using an ATV-mounted CME 750 drill rig equipped with hollow stem augers. The boring locations are shown in plan on the soil boring location map presented in Appendix B. Ground surface elevations at the boring locations were interpolated from a topographic map you provided to us, and verified during surveying by CGC personnel shortly after drilling. The elevations are referenced to Madison City datum and should be considered approximate.

Soil samples were obtained at 2.5-ft intervals for a depth of 10 ft and at 5-ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures Between Samples

The boring is extended downward, between samples, by a hollow-stem auger.

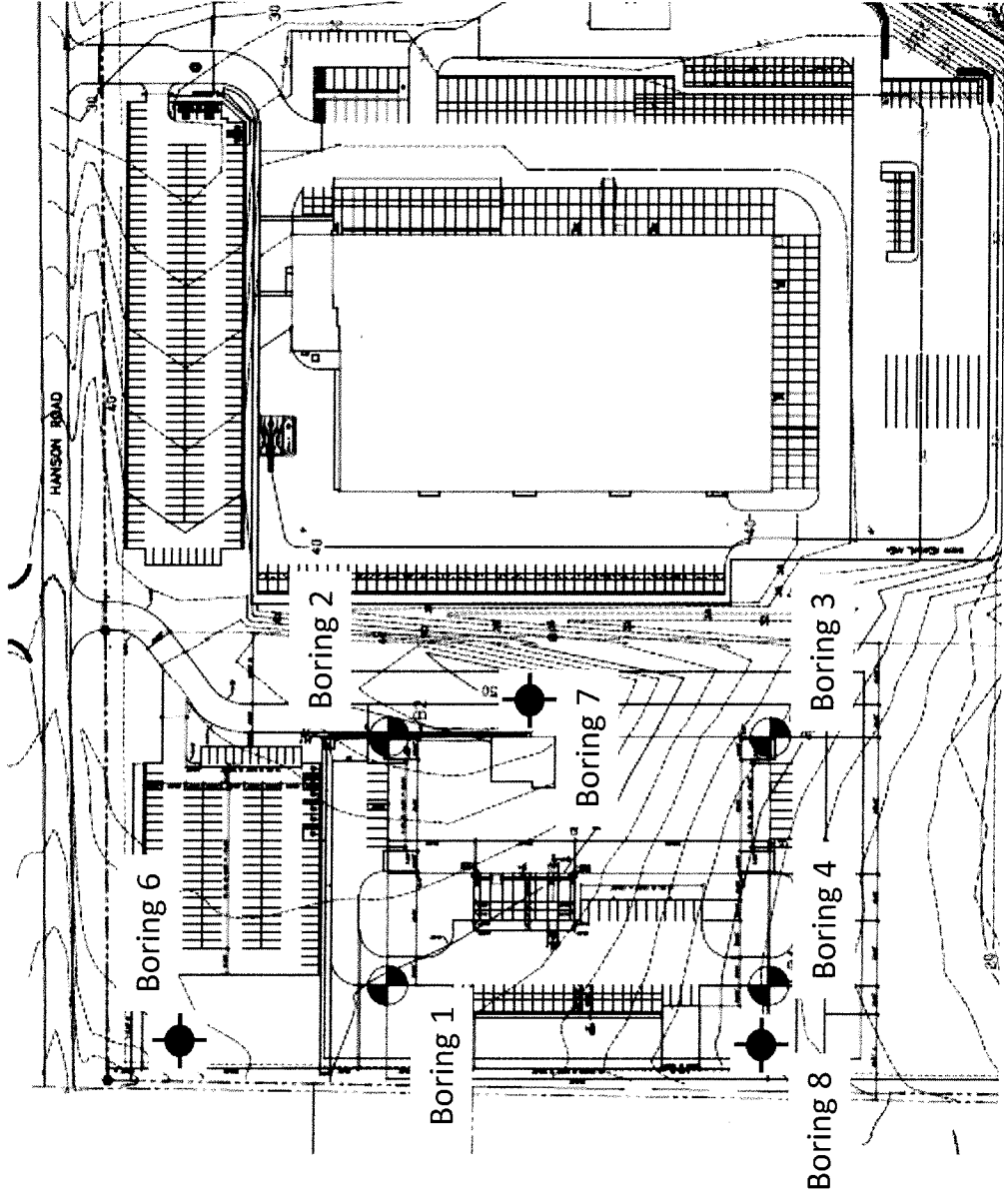
2. Standard Penetration Test and Split-Barrel Sampling of Soils
(ASTM Designation: D 1586)

This method consists of driving a 2-inch outside diameter split barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance. Recovered samples are first classified as to texture by the driller.

During the field exploration, the driller visually classified the soil and prepared a field log. Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite in accordance with WDNR regulations, and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

**SOIL BORING LOCATION MAP
LOGS OF TEST BORINGS (4)
LOGS OF PREVIOUS TEST BORINGS (3)
LOG OF TEST BORING - GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM**



Legend

- ⊗ Denotes Recent Boring Location and Number
- ◆ Denotes Prior Boring Location and Number

Notes

1. Borings drilled by Badger State Drilling on March 20, 2013.
2. Boring locations are approximate.
3. Base map provided by Ruedebusch Development and Construction.

Scale: Reduced

Date: 4/2013	CGC, Inc.
Job No. C13061	

SOIL BORING LOCATION MAP
 FedEx Addition
 Hanson Road
 Madison, Wisconsin



LOG OF TEST BORING

Project FedEx Addition
 Location Madison, Wisconsin

Boring No. 1
 Surface Elevation (ft) 41.2
 Job No. C13061
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	w	LL	PL	LI
1		18	M	6	Brown Silty/Clayey TOPSOIL Very Stiff, Brown Lean CLAY (CL)	(2.0)	23.7				
2		18	M	7	Loose, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)						
3		18	M	20	Medium Dense to Dense, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)						
4		18	M	19							
5		18	M	27							
6		10	M	50/3"							
					End Boring at 20 ft Borehole backfilled with bentonite chips						

WATER LEVEL OBSERVATIONS					GENERAL NOTES					
While Drilling	<input checked="" type="checkbox"/>	NW	Upon Completion of Drilling		Start	3/20/13	End	3/20/13		
Time After Drilling					Driller	Badger	Chief	KD	Rig	CME-750
Depth to Water					Logger	MC	Editor	AJB		
Depth to Cave in					Drill Method	2 1/4" HSA				
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.										



LOG OF TEST BORING

Project FedEx Addition
 Location Madison, Wisconsin

Boring No. 2
 Surface Elevation (ft) 49.2
 Job No. C13061
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL	LI
					0	Brown Silty/Clayey TOPSOIL					
1		18	M	10	1	Loose to Medium Dense, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)					
2		18	M	10	5						
3		18	M	17	10						
4		18	M	9	15						
					10	Dense, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)					
5		18	M	34	20	End Boring at 20 ft Borehole backfilled with bentonite chips					
6		18	M	31	25						

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling <input checked="" type="checkbox"/> <u>NW</u> Upon Completion of Drilling _____ Time After Drilling _____ Depth to Water _____ Depth to Cave in _____	Start <u>3/20/13</u> End <u>3/20/13</u> Driller <u>Badger</u> Chief <u>KD</u> Rig <u>CME-750</u> Logger <u>MC</u> Editor <u>AJB</u> Drill Method <u>2 1/4" HSA</u>
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.	



LOG OF TEST BORING

Project FedEx Addition
 Location Madison, Wisconsin

Boring No. 3
 Surface Elevation (ft) 35.2
 Job No. C13061
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL	LI
1		18	M	9	Brown Silty/Clayey TOPSOIL						
					Very Stiff to Hard, Brown Lean CLAY (CL)	(4.0+)	18.9				
2		15	M	14							
						(2.5)					
3		15	M	17	Medium Dense, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)						
4		18	M	18							
5		18	M	32	Dense, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)						
6		18	M	42							
					End Boring at 20 ft						
					Borehole backfilled with bentonite chips						

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling <input checked="" type="checkbox"/> <u>NW</u> Upon Completion of Drilling _____ Time After Drilling _____ Depth to Water _____ Depth to Cave in _____	Start <u>3/20/13</u> End <u>3/20/13</u> Driller <u>Badger</u> Chief <u>KD</u> Rig <u>CME-750</u> Logger <u>MC</u> Editor <u>AJB</u> Drill Method <u>2 1/4" HSA</u>
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.	



LOG OF TEST BORING

Project FedEx Addition
 Location Madison, Wisconsin

Boring No. 4
 Surface Elevation (ft) 41.5
 Job No. C13061
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL	LI
1		18	M	11	0-11	FILL: Brown Clayey SILT, Scattered Sand and Gravel Medium Dense, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM - Probable Fill)					
2		18	M	13	11-13						
3		18	M	15	13-15						
4		18	M	18	15-18	Loose to Medium Dense, Brown Fine to Medium SAND, Some Clay, Little Silt and Gravel (SP)					
5		18	M	9	18-20	Medium Dense, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)					
6		18	M	15	20-25	End Boring at 20 ft Borehole backfilled with bentonite chips					

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling <input checked="" type="checkbox"/> <u>NW</u> Upon Completion of Drilling _____ Time After Drilling _____ Depth to Water _____ Depth to Cave in _____	Start <u>3/20/13</u> End <u>3/20/13</u> Driller <u>Badger</u> Chief <u>KD</u> Rig <u>CME-750</u> Logger <u>MC</u> Editor <u>AJB</u> Drill Method <u>2 1/4" HSA</u>
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.	

LOGS OF PREVIOUS TEST BORINGS (3)



LOG OF TEST BORING

Project FedEx Distribution Center
 Location Hanson Road
Madison, Wisconsin

Boring No. 6
 Surface Elevation (ft) 42.0
 Job No. C03164
 Sheet 1 of 1

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL	LI
1		18	M	7	0-7	2" Brown Silty TOPSOIL Very Stiff, Brown Lean CLAY, Trace to Little Sand (CL)	(3.5)				
2		17	M	9	7-9	Loose, Brown Fine SAND, Some Silt, Trace Gravel (SM)					
3		18	M	18	9-18	Medium Dense to Dense, Brown Fine to Medium SAND, Some Silt, Little Gravel (SM)					
4		18	M	25	18-25						
5		18	M	32	25-32						
End Boring at 15 ft											
Borehole backfilled with bentonite chips											

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling NW Upon Completion of Drilling _____
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start 7/17/03 End 7/17/03
 Driller Badger Chief JT Rig CME-55
 Logger JT Editor WWW
 Drill Method 2 1/4" HSA

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project FedEx Distribution Center
Hanson Road
 Location Madison, Wisconsin

Boring No. 7
 Surface Elevation (ft) 50.7
 Job No. C03164
 Sheet 1 of 1

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
1	18	M	5	5	Loose, Reddish Brown Fine to Medium SAND, Some Silt, Little Gravel (SM) Medium Dense to Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Occasional Cobbles and Boulders (SM)					
2	17	M	17	5						
3	17	M	18	5						
4	18	M	23	10						
5	18	M	51	15						
6	18	M	52	20						
End Boring at 20 ft										
Borehole backfilled with bentonite chips										

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling NW Upon Completion of Drilling _____
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start 7/9/03 End 7/9/03
 Driller Badger Chief JT Rig CME-55
 Logger JT Editor WWW
 Drill Method 2 1/4" HSA

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, , *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not Informed.*

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

SUBSURFACE CONDITIONS CAN CHANGE

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report that was:*

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

Site exploration identifies subsurface conditions only at those points where surface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion, geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's recommendations if we do not perform construction observation.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having CGC participate in prebid and preconstruction conferences, and by providing construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time to perform additional study.* Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes

labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

GEOENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of ASFE, for more information.

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ASFE/The Best People on Earth
881 Colesville Road, Suite G 106
Silver Spring, MD 20910

APPENDIX D

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX D

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

**Table 1
Gradation of Special Fill Materials**

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55	75 (2)		
No. 40			5-20	8-28	10-35	15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction*.
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

**Table 2
Compaction Guidelines**

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
<u>Within 10 ft of building lines</u>		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
<u>Beyond 10 ft of building lines</u>		
Under walks and pavements		
- Less than 3 ft below subgrade	92	95
- Greater than 3 ft below subgrade	90	90
Landscaping	85	90

Notes:

1. Based on Modified Proctor Dry Density (ASTM D 1557)

CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing
March 26, 2009
C09046

Mr. Mike Ruedebusch
Ruedebusch Development & Construction
4605 Dovetail Drive
Madison, Wisconsin 53704

Re: Field Report No. 1
FedEx Expansion
Madison, Wisconsin

Dear Mr. Ruedebusch:

This report summarizes testing services conducted by CGC staff at the above-referenced project on an intermittent basis between March 2, 2009 and March 18, 2009. During our twelve site visits, which were arranged by your firm, we observed footing subgrade soil conditions, observed proof-rolls of the south loading dock area as well as the warehouse interior slab subgrade, performed field density tests (FDTs) on compacted fill and conducted field testing on concrete delivered to the site. The following paragraphs discuss our observations in more detail.

SUBGRADE OBSERVATIONS

During our site visits on March 2, 3, 5 and 16, we observed soil subgrade conditions at the base of perimeter and interior footing excavations for the warehouse expansion as well as perimeter footings for the office addition. (See attached Table 1). In general, we observed natural granular soils at the base of the excavations.

We expressed our opinion that the observed soil subgrade conditions appeared satisfactory for foundations proportioned for an allowable soil bearing pressure of 3500 psf. This opinion is based on our visual observations, rod probe penetrations (using a 5/8-in. diameter hand-held steel rod) performed at or near footing grade, as well as soil boring information contained in the geotechnical report prepared for this project (see CGC Report No. C03164 dated July 23, 2003 not attached).

PROOF-ROLL OBSERVATIONS

CGC personnel observed a proof-roll during our site visit on March 17, 2009. The proof-roll was also observed by Mike Ruedebusch (Ruedebusch Development and Construction) and Jerry Kavon (Kavon Excavating). A loaded quad axle dump truck was used to perform the proof-roll of two areas. Area 1 is the south loading dock area (from grid C.8 to F.9 and south of grid 12.9). The area measured 130 ft x 50 ft. No deflection or rutting was observed in the area. CGC did recommend that a approximately 15 ft wide x 50 ft long area at the southwest corner of the loading dock area be "cleaned up" to remove approximately 6-in. of disturbed /muddy soils prior to placement of 6-in. of crushed stone.

Mr. Mike Ruedebusch
Ruedebusch Development & Construction
March 26, 2009
Page 2

Area 2 was the interior of the proposed warehouse expansion. This area is to receive a slab on grade. A proof-roll was requested to confirm the suitability of the existing grade prior to placement of 6-in. of ¾-in. gravel with fines. No deflection or rutting was observed in the area. In our opinion the observed subgrades are suitable for the support of the proposed reinforced concrete slab.

FIELD DENSITY TESTING

During one site visit, a total of three field density tests were performed within on-site granular soils placed as interior wall backfill. In general, the test results (attached) for the fill placed met the required 95% compaction level at the elevations and locations tested based on modified Proctor methods (ASTM D1557). Rod probe penetrations (using a handheld 5/8-in. diameter steel rod) typically ranged from 4 to 6 in. in the granular soils within the fill areas tested and adjacent non-tested areas, implying uniformity in the compaction process.

CONCRETE TESTING

During six site visits we conducted field testing (i.e., air, slump, temperature) on concrete delivered to the site to construct portions of the footings and foundation walls of the facility. The results of the field tests were generally within project specification limits. The field test results were submitted to on-site personnel after the tests were completed. During each site visit, one set of four cylinders was cast for compressive strength testing. The compressive strength test results for the concrete samples will be or have been submitted to you separately.

LABORATORY TESTING

A sample of fill from the site was returned to our laboratory to develop a modified Proctor curve (results attached). The maximum dry density information from the curve was/will be used to calculate in-place compaction values.


CGC, Inc.

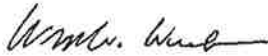
Mr. Mike Ruedebusch
Ruedebusch Development & Construction
March 26, 2009
Page 3

We trust this report addresses your present needs. If you have any questions, please contact us.

Sincerely,

CGC, Inc.


Kirk J. Solberg
Project Geologist



William W. Wuellner, P.E.
Senior Geotechnical Engineer

Encl: Table 1 – Footing Subgrade Observations
Field Density Test Report No. 1
Moisture Density Curve (1)

Table 1
Footing Subgrade Observations
FedEx Expansion
Madison, Wisconsin

Date	Location	Footing Bearing Soil Description	Rod Probe Penetrations, in.	Pocket Penetrometer Readings, ton/sq ft	Comments
South Perimeter Footing:					
3/2/09	From Existing Building West to Southwest Corner	Light Brown Fine to Medium Sand, Some Silt and Gravel	≤ 4	-	Recommended recompacting this layer. Sands loosened as a result of excavation. Satisfactory ⁽¹⁾ .
West Perimeter Footing:					
3/3/09	From Existing Building South to Southwest Corner	Light Brown Fine to Medium Sand, Some Silt and Gravel	≤ 4	-	Recommended recompacting this layer. Sands loosened as a result of excavation. Satisfactory ⁽¹⁾ .
3/5/09	Interior Column Pads at E-11, E-12, F-11 and F-12	Brown Fine Silty Sand and Gravel	2 - 4	-	Recommended recompaction of subgrade with hoe-pak following excavation. Satisfactory ⁽¹⁾ .
Perimeter Footings - Office Area Expansion:					
3/16/09	North Footing	Light Brown Fine to Medium sand, Some Silt and Gravel	≤ 4	-	Satisfactory ⁽¹⁾ .
3/16/09	West Footing	Light Brown Fine to Medium Sand, Some Silt and Gravel	≤ 6	-	Several small portions of footing subgrade comprised of clear stone used to backfill relocated utilities. Isolated areas with rod-probes to 8 in. Recommended recompaction. Satisfactory ⁽¹⁾ .

⁽¹⁾ Based on an allowable soil bearing pressure of 3,500 psf.

FIELD DENSITY TEST REPORT - NO. 1

CGC, Inc., 2921 Perry Street, Madison, WI 53713 - Phone (608) 288-4100 - Fax (608) 288-7887

PROJECT: FedEx Expansion
Madison, WI

TO: Ruedebusch Development & Construction
4605 Dovetail Drive
Madison, WI 53704

ATTN: Mr. Mike Ruedebusch

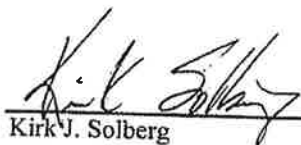
TEST METHODS: Moisture-density relationship of soils based on MODIFIED Proctor (ASTM D1557)
"METHOD" indicates: (N) Nuclear (ASTM D2922) or (S) Sand Cone (ASTM D1556)

Test No.	O	D	Location	Elevation (ft)	Distance (1) Below Surface (in)	Description of Material Tested	Moisture %	Dry Density lb/cu ft	Maximum Density lb/cu ft	Meas. Comp.	Spec. Comp.
<u>03-11-09</u>											
<u>Interior Wall Backfill</u>											
1	N		4'N, 29'E of Building Corner, F9/12.9	99	0	Orange Brown Fine to Medium Sand, Little Silt and Gravel	8.2	115.7	117	99%	95%
2	N		3'N, 52'E of Building Corner, F9/12.9	99	0	Orange Brown Fine to Medium Sand, Little Silt and Gravel	8.3	115.1	117	98%	95%
3	N		2'N, 5'E of Building Corner, F9/12.9	99	0	Orange Brown Fine to Medium Sand, Little Silt and Gravel	7.8	113.0	117	97%	95%

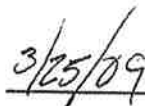
* Indicates measured compaction below specification.

Comments: (1) Test elevations are referenced to finish floor slab at EL 100.0' (assumed datum).

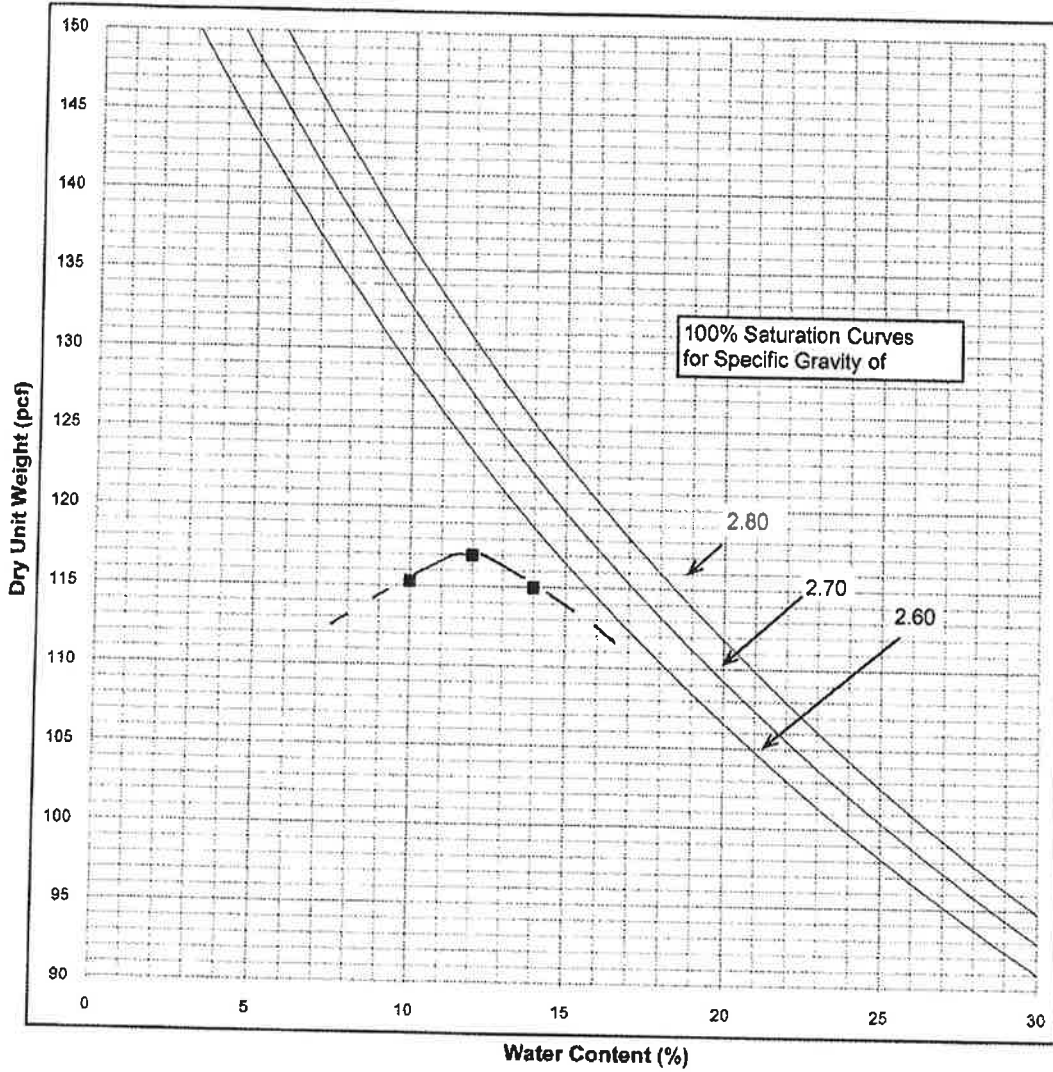
Signed


Kirk J. Solberg

Dated



TEST REPORT



Specimen No.	Maximum Dry Unit Weight, pcf	Optimum Water Content, %
1	117.0	12.0
Specimen Description		
Orange Brown Fine to Medium Sand, Little Silt and Gravel		
Corrected Maximum Dry Unit Weight, pcf	Corrected Optimum Water Content, %	
n/a	n/a	
Test Method	Liquid Limit	Plastic Limit
ASTM D1557-91, Method A	-	-
Preparation Method	% Gravel	% Sand
Dry	11.1	-
		Plasticity Index
		-
		Specific Gravity
		2.7 (est.)
		% Fines
		-
		% Oversize
		-

PROJECT: FedEx Expansion
 Madison, WI
 PROJECT NUMBER: C09046

**LABORATORY
 COMPACTION TEST**

CGC, Inc.

CHECKED BY: MAS REVIEWED BY: MNS

11-Mar-09

CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

September 29, 2009
C09046

Mr. Mike Ruedebusch
Ruedebusch Development & Construction
4605 Dovetail Drive
Madison, Wisconsin 53704

Re: Field Report No. 2
Fed-Ex Expansion
Madison, Wisconsin

Dear Mr. Ruedebusch:

This report summarizes testing services conducted by CGC staff at the above-referenced project on an intermittent basis between April 10, 2009 and July 2, 2009. During our twenty-nine site visits, which were arranged by your firm, we observed footing subgrade conditions, performed field density tests (FDTs) on compacted fill, observed proof-rolls of parking lot areas and conducted field testing on concrete delivered to the site. The following paragraphs discuss our observations in more detail.

SUBGRADE OBSERVATIONS

During our site visits on June 17 and 26, we observed soil subgrade conditions at the base of the retaining walls to be constructed along the south/southeast and east/southeast perimeter of the south parking lot area (see attached Table 1). In general, we observed natural lean clays or sands at the base of the excavations. Note that a localized area measuring 45 ft x 18 ft required a 1.5 ft undercut to remove unsuitable soils. Subgrade to be re-established with 3-in. breaker stone. (See Attached Undercut Diagram).

We expressed our opinion that the observed soil subgrade conditions appeared satisfactory for support of the modular block retaining wall using an assumed allowable soil bearing pressure of 2000 psf. This opinion is based on our visual observations, rod probe penetrations (using a 5/8-in. diameter hand-held steel rod) and pocket penetrometer readings (an estimate of the unconfined compressive strength of cohesive soils) performed at or near footing grade, as well as soil boring information contained in the geotechnical report prepared for this project (see CGC Report No. C03164 dated July 23, 2003, not attached).

During our site visit on June 4, CGC observed the excavation to subgrade in an area of "cut" in the eastern parking lot strip (trailer parking). During excavation to subbase grade, wet unsuitable soils were exposed. The saturated soils extended 7.5 ft below subgrade. The undercut exposed natural

Mr. Mike Ruedebusch
Ruedebusch Development & Construction
September 29, 2009
Page 2

gray silts and clay. Rod probe penetrations (using a 5/8-in. diameter hand held steel rod) were on the order of 0-2 in. The undercut extended the full width of the trailer parking area for a length of approximately 125 ft. The subgrade was re-established with 3-in. breaker rock and 3/4 in. gravel and compacted. (See attached undercut diagram).

FIELD DENSITY TESTING

During eleven site visits, a total of 32 field density tests were performed within on-site granular soils placed in parking lot areas as part of general site grading for this project. Additionally, we tested imported soils used to backfill the retaining walls. In general, the test results (attached) for the fill placed met the required 95% compaction level at the elevations and locations tested based on modified Proctor methods (ASTM D1557) for the parking lot fills and standard Proctor (ASTM D698) for the retaining wall backfill. Rod probe penetrations (using a handheld 5/8-in. diameter steel rod) typically ranged from 2 to 3 in. in the granular soils within the fill areas tested and adjacent non-tested areas, implying uniformity in the compaction process.

PROOF-ROLL OBSERVATIONS

During our site visits on April 24, June 3, 4, 5 and 30, CGC observed proof-rolls in parking lot areas prior to placement of fill to establish site grades as well as prior to paving parking lot areas. The following paragraphs discuss our observations in more detail.

On April 24, CGC observed proof-rolls in three areas along the west, south, northeast sides of the facility. A loaded 627 Cat scraper was used to perform the proof-rolls:

Area 1 located along the west side of the existing western drive lane. No deflection or rutting was observed under loaded scraper traffic. In our opinion, this area was suitable to receive fill to establish site grades.

Area 2 located along the south side of the existing south parking lot. Wet soils were observed with deflection observed in the area. Kavon Excavating planned to remove 4 to 6 in. of the wet soils prior to fill placements. A follow-up proof-roll was scheduled.

Area 3 is a small area located at the northeast corner of the existing east parking lot, no deflection was observed under loaded tri-axle truck traffic. In our opinion, this area was suitable to receive fill to establish site grades.

Mr. Mike Ruedebusch
Ruedebusch Development & Construction
September 29, 2009
Page 3

On June 3, CGC observed a proof-roll of the south parking lot subgrade following removal of previously reported wet soils. Some areas of deflection were observed under loaded scraper traffic and deep (8-10 in.) rod probe penetrations were observed along the southern end of the proposed lot. Kavon Excavating proposed moisture conditioning the soils to allow to dry. A follow-up proof-roll would be performed following moisture conditioning. One localized area measuring 78x9 ft was undercut 2 ft to remove yielding soils. (See attached undercut diagram).

On June 4, CGC observed a proof-roll of the west lot area utilizing a loaded quad axle dump truck. No areas of deflection or rutting were observed. In our opinion, this area was suitable for support of the proposed asphalt pavement. We also observed a proof-roll of the areas previously laid out in the south lot for moisture conditioning. Following this proof-roll, it was apparent due to rutting and deflection that additional moisture conditioning was necessary.

On June 5, CGC observed a proof-roll of the south lot area following two days of moisture conditioning. Portions of the lot showed no deflection or rutting under loaded quad axle traffic. An area was identified and laid out for a 2-ft undercut to remove unsuitable soils (see attached undercut diagram). The subgrade was re-established with 1.5 ft of 3-in. breaker rock and 6 in. of 3/4 in. gravel. In our opinion, following undercut and re-establishing of subgrade and compaction, the observed subgrade was suitable for asphaltic pavement support.

On June 30, CGC observed a proof-roll of a 100x100 ft area at the southeast end of the south parking lot area. A loaded triaxle dump truck was utilized to perform the proof-roll on the existing grade, which was approximately 2 in. below final subgrade. No rutting or deflection was observed in this area. In our opinion, this area was suitable for placement of 3-in. breaker rock and base course to establish the subgrade elevation as well as subsequent asphalt pavement support.

CONCRETE TESTING

During eleven site visits we conducted field testing (i.e., air, slump, temperature) on concrete delivered to the site to construct portions of the footings, foundation walls and slabs on grade at the facility. The results of the field tests were generally within project specification limits. The field test results were submitted to on-site personnel after the tests were completed. During each site visit, one set of 4 cylinders was cast for compressive strength testing. The compressive strength test results for the concrete samples will be or have been submitted to you separately.



Mr. Mike Ruedebusch
Ruedebusch Development & Construction
September 29, 2009
Page 4

LABORATORY TESTING

A sample of on-site fill used to establish grades in the parking lot areas was returned to our laboratory to develop a modified Proctor curve (results attached). A sample of the crushed aggregate base course used as retaining wall backfill was delivered to our laboratory to develop a standard Proctor curve (results attached). The maximum dry density information from the curves was used to calculate in-place compaction values.

We trust this report addresses your present needs. If you have any questions, please contact us.

Sincerely,

CGC, Inc.

Kirk J. Solberg
Project Geologist

William W. Wuellner, P.E.
Senior Geotechnical Engineer

Encl: Table 1 – Retaining Wall Subgrade Observations
Field Density Test Report No.1
Moisture Density Curves (2)
Diagram of Undercuts

Table 1
Footings Subgrade Observations
Fed-Ex Expansion
Madison, Wisconsin

Date	Location	Footings Bearing Soil Description	Rod Probe Penetrations, in.	Pocket Penetrometer Readings, ton/sq ft	Comments
6/17/09	North and South Portions of the South/Southeast Retaining Wall	Fill: Mixture of Gray/Brown Lean Clay and Brown Fine to Medium Sand, Some Gravel and Silt	1 - 3	1.5 - 2.5	Satisfactory ⁽¹⁾
6/17/09	Central Portion of the South/Southeast Retaining Wall	Native Gray Lean Clay to Sandy Lean Clay	0.5 - 1	3.0 to 4.5+	Satisfactory ⁽¹⁾
6/26/09	East/Southeast Retaining Wall	Native Brown Lean Clay	0 - 1	3.0 - 3.5	Satisfactory ⁽¹⁾ . Localized area at north end 45' x 18' required a 1.5' undercut to remove unsuitable saturated soils. Subgrade re-established with 3" breaker rock and compacted.

Notes:

⁽¹⁾ Based on an allowable soil bearing pressure of 2,000 psf.



Job No.	C09046
Tested By:	JCS
Date:	9/29/2009

FIELD DENSITY TEST REPORT - NO. 1

CGC, Inc., 2921 Perry Street, Madison, WI 53713 - Phone (608) 288-4100 - Fax (608) 288-7887

PROJECT: Fed-Ex Expansion

TO: Ruedebusch Development & Construction
 4605 Dovetail Drive
 Madison, WI 53704

ATTN: Mr. Mike Ruedebusch

TEST METHODS: Moisture-density relationship of soils based on MODIFIED Proctor (ASTM D1557)
 "METHOD" indicates: (N) Nuclear (ASTM D2922) or (S) Sand Cone (ASTM D1556)

Test No.	METHOD	Location	(1) Elevation (ft)	(2) Distance Below Surface (in)	Test Fill	Description of Material Tested	Moisture %	Dry Density lb/cu ft	Maximum Density lb/cu ft	Meas. Comp.	Spec. Comp.	
5/4/09		<u>Fill for Parking Lot Grade</u>										
1	N	45'S, 100'W of Southeast Light Post Near Concrete Block Structure	99.0	0		Light Brown Fine to Medium Sand, Some Silt and Gravel	3.8	132.1	135.5	97%	95%	
2	N	45'S, 200'W of Southeast Light Post Near Concrete Block Structure	99.0	0		Light Brown Fine to Medium Sand, Some Silt and Gravel	4.4	131.5	135.5	97%	95%	
3	N	90'W of Northwest Corner of Existing Building	99.0	0		Light Brown Fine to Medium Sand, Some Silt and Gravel	4.6	132.8	135.5	98%	95%	
4	N	75S, 90'W of Northwest Corner of Existing Building	99.0	0		Light Brown Fine to Medium Sand, Some Silt and Gravel	4.4	131.9	135.5	97%	95%	
5	N	150'S, 90'W of Northwest Corner of Existing Building	99.0	0		Light Brown Fine to Medium Sand, Some Silt and Gravel	4.7	128.7	135.5	95%	95%	

M E T H O D	Test No.	Location	(1)	Distance	Description of Material Tested	Moisture %	Dry	Maximum	Meas. Comp.	Spec. Comp.
			(2)	Below			Density	Density		
			Test Elevation (ft)	Fill Surface (In)			lb/cu ft	lb/cu ft		
	6	N 250'S, 90'W of Northwest Corner of Existing Building	99.0	0	Light Brown Fine to Medium Sand, Some Silt and Gravel	4.3	135.0	135.5	100%	95%
	7	N 45'S, 20'E of Southeast Light Post by Concrete Block Structure	99.0	0	Light Brown Fine to Medium Sand, Some Silt and Gravel	3.9	135.0	135.5	100%	95%
	8	N 45'S, 40'W of Southeast Light Post by Concrete Block Structure	99.0	0	Light Brown Fine to Medium Sand, Some Silt and Gravel	4.1	130.2	135.5	96%	95%
<u>6/18/09</u>										
<u>SSE Retaining Wall Backfill</u>										
	9	N 6'S, 5'W of North Side of SSE Retaining Wall	101.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.2	127.7	136.5	94% *	95%
	10	N Retest of Test #9	101.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.3	130.1	136.5	95%	95%
	11	N 15'S, 6'W of North End of SSE Retaining Wall	101.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.9	130.1	136.5	95%	95%
<u>6/22/09</u>										
<u>SSE Retaining Wall Backfill</u>										
	12	N 12'S, 10'W of North End of SSE Retaining Wall	103.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.7	137.8	136.5	101%	95%
	13	N 3'N, 6'E of West End of SSE Retaining Wall	103.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.2	137.3	136.5	101%	95%
	14	N 15'N, 15'E of West End of SSE Retaining Wall	103.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.4	137.3	136.5	101%	95%
<u>6/23/09</u>										
<u>SSE Retaining Wall Backfill</u>										
	15	N 12'N, 12'E of West End of SSE Retaining Wall	105.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.8	133.9	136.5	98%	95%

Test No.	D	Location	Elevation (ft)	Distance (2) Below Fill Surface (in)	Description of Material Tested	Moisture %	Density		Meas. Comp.	Spec. Comp.
							Dry lb/cu ft	Maximum lb/cu ft		
16	N	20'N, 10'E of West End of SSE Retaining Wall	105.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.9	126.6	136.5	93% *	95%
17	N	Retest of Test No. 16	105.3	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.6	132.2	136.5	97%	95%
<u>6/24/09</u>										
<u>SSE Retaining Wall Backfill</u>										
18	N	10'S, 10'W of North End of SSE Retaining Wall	106.6	10	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.7	138.4	136.5	101%	95%
19	N	10'N, 25'E of West End of SSE Retaining Wall	106.6	10	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.6	133.3	136.5	98%	95%
20	N	19'S, 10'W of North End of SSE Retaining Wall	106.6	10	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.0	138.0	136.5	101%	95%
21	N	10'S, 8'W of North End of SSE Retaining Wall	108.0	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	4.3	131.4	136.5	96%	95%
<u>6/29/09</u>										
<u>ESE Retaining Wall Backfill</u>										
22	N	STA 1+05, 4' From Front of Wall	101.5	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.8	130.1	136.5	95%	95%
23	N	STA 0+75, 12.5' From Front of Wall	101.5	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.1	129.4	136.5	95%	95%
<u>7/1/09</u>										
<u>ESE Retaining Wall Backfill</u>										
24	N	STA 1+40, 7.5' From Front of Wall	110.5	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	8.1	132.9	136.5	97%	95%
25	N	STA 0+65, 6.0' From Front of Wall	110.5	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	7.3	129.7	136.5	95%	95%

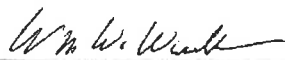
Test No.	O	D	Location	Elevation (ft)	Distance (2) Below Surface (in)	Description of Material Tested	Moisture %	Dry Density lb/cu ft	Maximum Density lb/cu ft	Meas. Comp.	Spec. Comp.
<u>SSE Retaining Wall Backfill</u>											
26	N		15'S, 10'W of North End of SSE Retaining Wall	110.5	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	6.8	136.7	136.5	100%	95%
<u>7/2/09</u>											
<u>ESE Retaining Wall Backfill</u>											
27	N		STA 1+00, 6' Off Wall, 5' Off Stone	114.0	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.6	137.5	136.5	101%	95%
28	N		STA 0+30, 4' Off Wall	114.0	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.3	138.1	136.5	101%	95%
<u>7/6/09</u>											
<u>ESE Retaining Wall Backfill</u>											
29	N		STA 1+62, 5' From Front of Wall	110.0	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	4.8	131.5	136.5	96%	95%
30	N		STA 0+10, 5' From Front of Wall	110.0	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	5.5	131.6	136.5	96%	95%
<u>7/8/09</u>											
<u>ESE Retaining Wall Backfill</u>											
31	N		STA 0+95, 10' From Front of Wall	112.0	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	7.5	131.1	136.5	96%	95%
32	N		STA 0+5, 5' From Front of Wall	112.0	0	Brown Fine to Coarse Sand and Gravel, Some Silt (3/4" CABC)	7.1	132.0	136.5	97%	95%

Comments:

(1) Test elevations referenced to site datum.

(2) Test elevations for South/Southeast and East/Southeast retaining walls based on bottom of retaining wall at EL 100.0 (Designated datum).

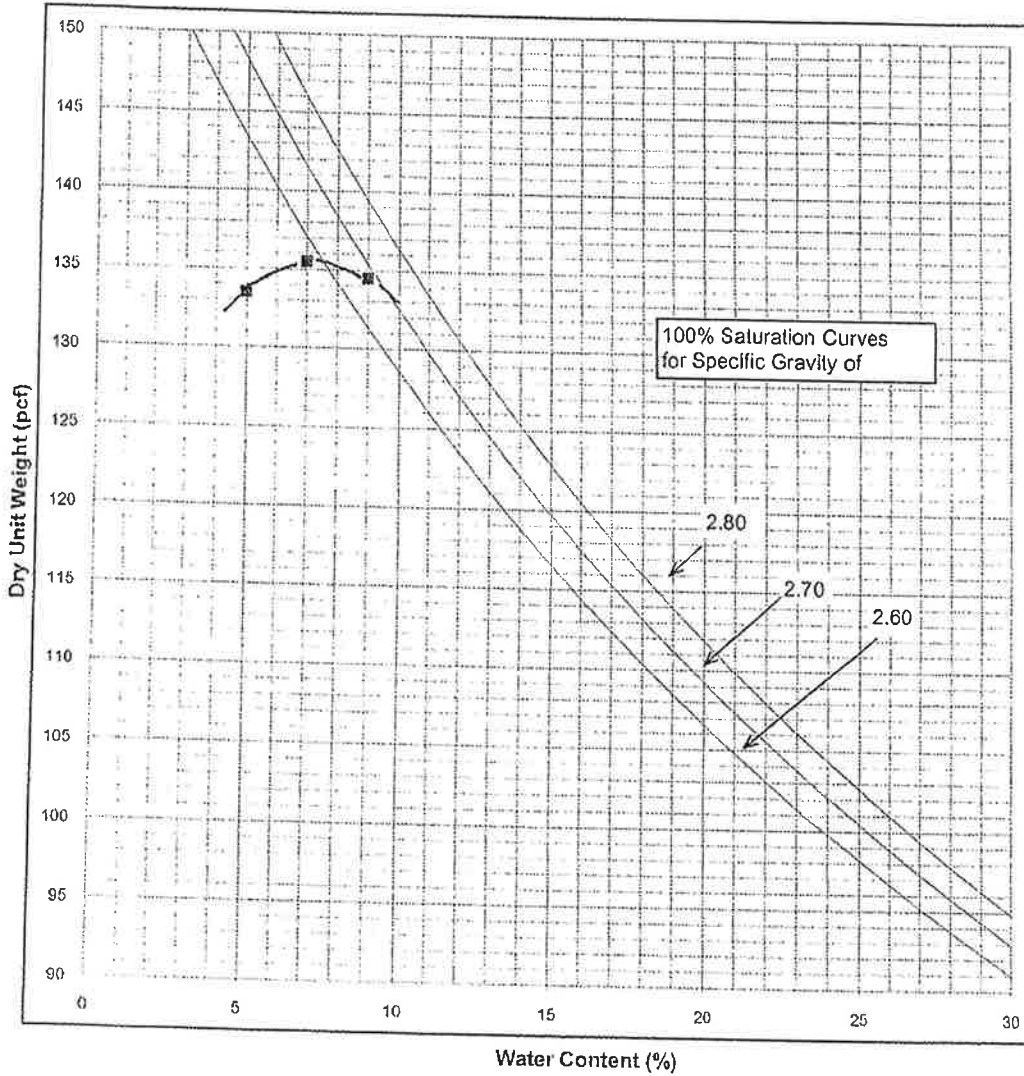
Signed


 Bill Wuellner, P.E.

Dated

9/29/09

TEST REPORT



Specimen No.	Maximum Dry Unit Weight, pcf	Optimum Water Content, %
1	135.5	7.0
Specimen Description		
Light Brown Fine to Medium Sand, Some Silt and Gravel		
Corrected Maximum Dry Unit Weight, pcf	Corrected Optimum Water Content, %	
See above	n/a	
Test Method	Liquid Limit	Plastic Limit
ASTM D1557, Method B	-	-
Preparation Method	% Gravel	% Sand
Dry	21.3	-
		Plasticity Index
		-
		Specific Gravity
		2.7 (est.)
		% Fines
		-
		% Oversize
		-

PROJECT: Fed-Ex Expansion
 Madison, Wisconsin
 PROJECT NUMBER: C09046

**LABORATORY
 COMPACTION TEST**

CGC, Inc.

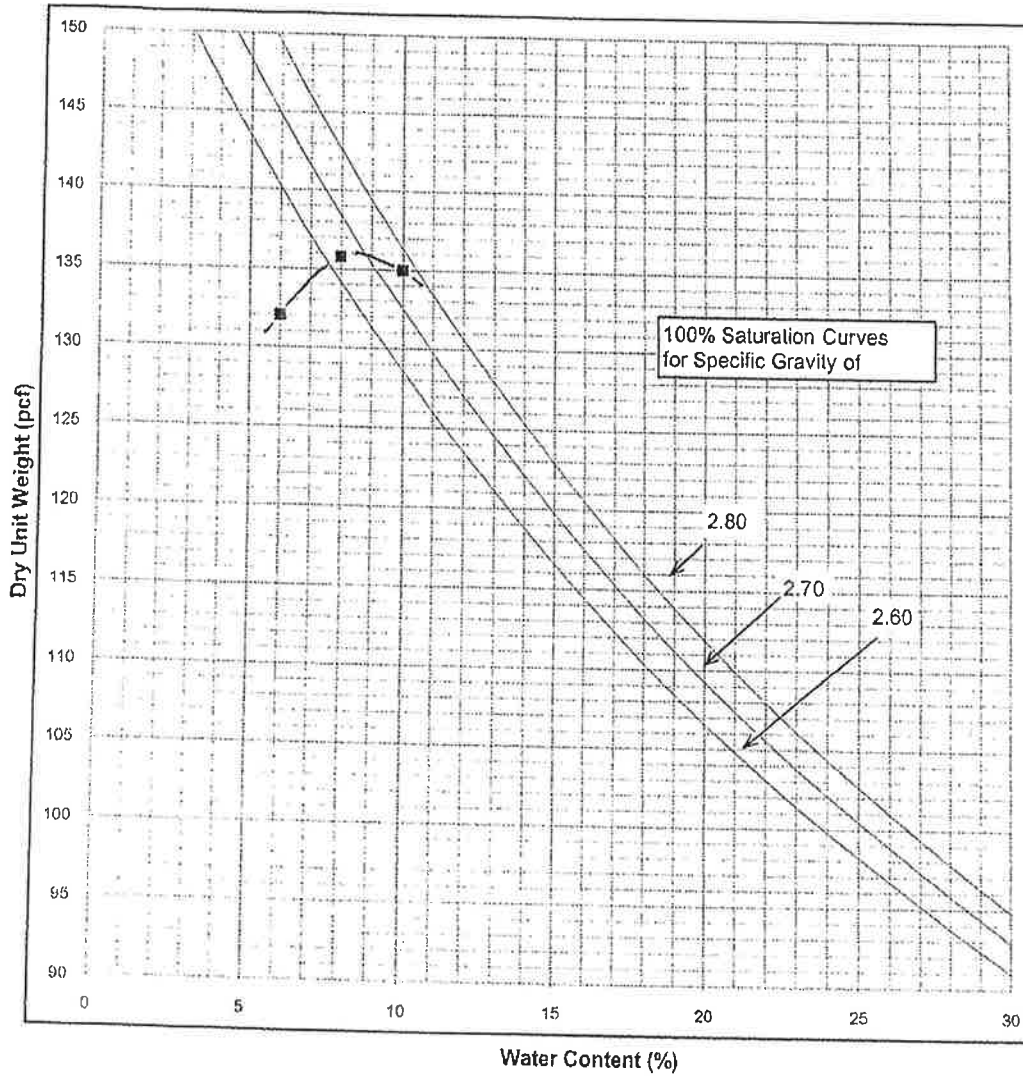
CHECKED BY:

KJS

REVIEWED BY:

4-May-09

TEST REPORT



Specimen No.	Maximum Dry Unit Weight, pcf	Optimum Water Content, %
2	136.5	9.0
Specimen Description		
Brown, Fine to Coarse Sand and Gravel, Some Silt		
Corrected Maximum Dry Unit Weight, pcf	Corrected Optimum Water Content, %	
See above	n/a	
Test Method	Liquid Limit	Plastic Limit
ASTM D698, Method D	-	-
Preparation Method	% Gravel	% Sand
Dry	42.7	-
	Plasticity Index	Specific Gravity
	-	2.7 (est.)
	% Fines	% Oversize
	-	-

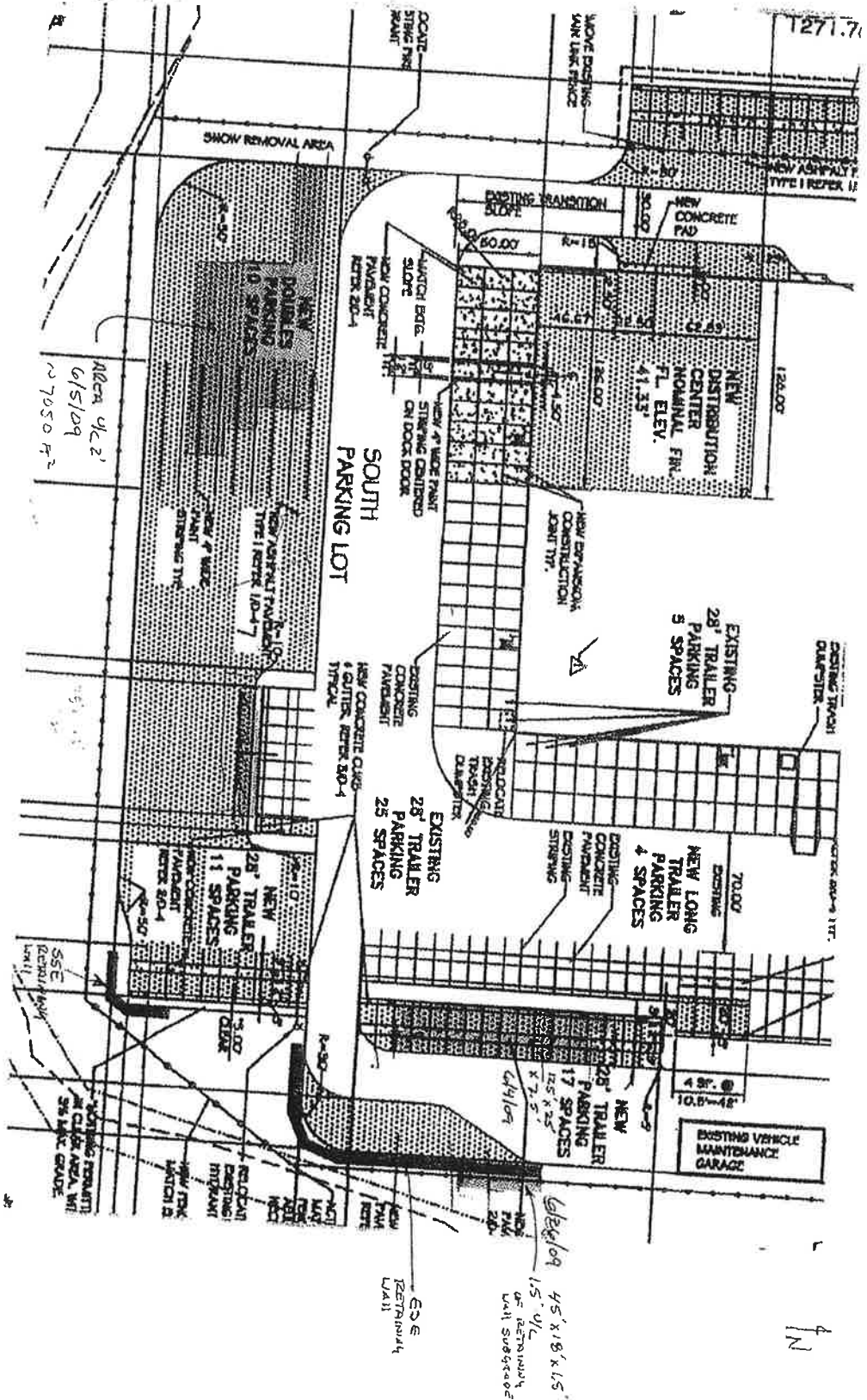
PROJECT: Fed-Ex Expansion
 Madison, Wisconsin
 PROJECT NUMBER: C09046

**LABORATORY
 COMPACTION TEST**

CGC, Inc.

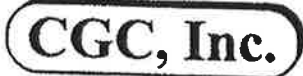
CHECKED BY: FHC REVIEWED BY: KJS

17-Jun-09



Order Diagram

4



Job No: C09046
Test No: 7010

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	702350
Truck #:	127	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	KJS of CGC	Date Made:	3/3/09
Specified Strength (psi):	3000	Specified Range (ins):	0-3.00
Slump (ins):	3.00	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	62		
Air Temp (deg f):	20		

Batched: 12:00 Delivered: 12:19 Unloaded: 12:39

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

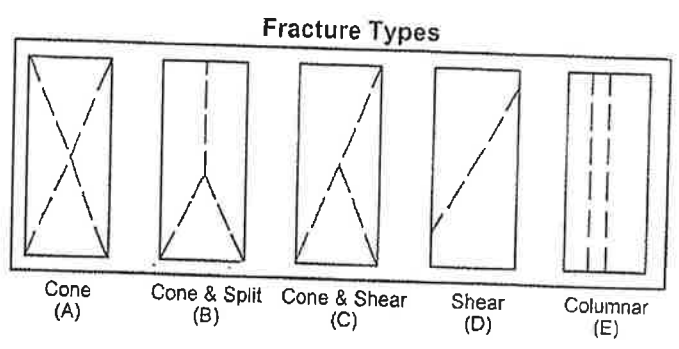
Test Data

Location: Perimeter Footing South (Set 1)

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	3/4/09	6.00	28.27	3/10/09	7	A	116990	4140	138
2	3/4/09	5.98	28.09	3/31/09	28	A	154780	5510	184
3	3/4/09	5.98	28.09	3/31/09	28	A	156950	5590	186
4	3/4/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis
Date: 3/31/09





Job No: C09046
Test No: 7011

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	702375
Truck #:	29	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	KJS of CGC	Date Made:	3/3/09
Specified Strength (psi):	3000	Specified Range (ins):	0-3.00
Slump (ins):	2.50	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	59		
Air Temp (deg f):	20		

Batched: 1:20

Delivered: 1:50

Unloaded: 3:00

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Perimeter Footing South (Set 2)

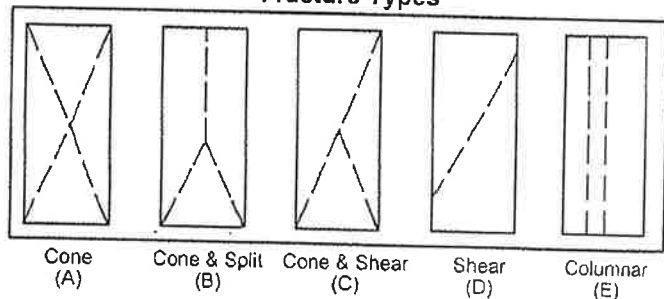
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	3/4/09	5.97	27.99	3/10/09	7	A	115700	4130	138
2	3/4/09	5.97	27.99	3/31/09	28	A	156380	5590	186
3	3/4/09	5.97	27.99	3/31/09	28	A	155580	5560	185
4	3/4/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kimi Lewis

Date: 3/31/09

Fracture Types





Job No: C09046
Test No: 7030

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	702502
Truck #:	162	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	TV of CGC	Date Made:	3/4/09
Specified Strength (psi):	3000	Specified Range (ins):	0-3.00
Slump (ins):	2.75	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	62		
Air Temp (deg f):	34		

Batched: 9:34 Delivered: 9:56 Unloaded: 10:05

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

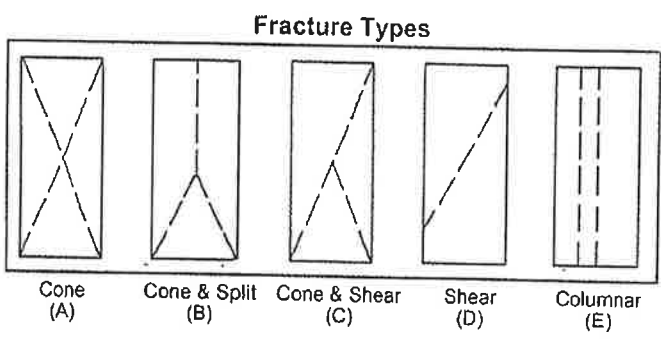
Test Data

Location: Footing: F.9 Line from 9.7 to 12

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	3/5/09	6.00	28.27	3/11/09	7	A	117410	4150	138
2	3/5/09	6.01	28.37	4/1/09	28	A	158220	5580	186
3	3/5/09	6.00	28.27	4/1/09	28	A	152000	5380	179
4	3/5/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Daws
Date: 4-1-09





Job No: C09046
Test No: 7043

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	702692
Truck #:	75	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.00
Made by:	KJS of CGC	Date Made:	3/5/09
Specified Strength (psi):	4000		
Slump (ins):	4.00	Specified Range (ins):	0-4.00
Air (%):	5	Specified Range (%):	5-7
Concrete Temp (deg f):	75	Specified Range (deg f):	-
Air Temp (deg f):	42		

Batched: 10:40 Delivered: 11:00 Unloaded: 11:05

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

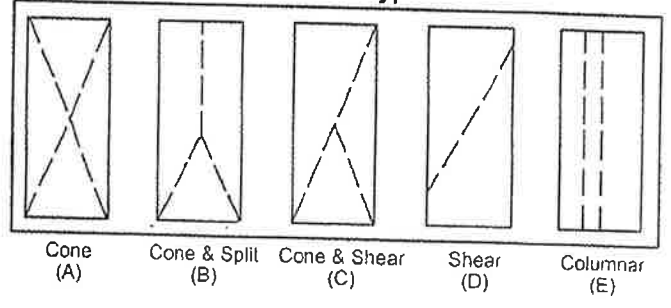
Location: Storm Wall - South

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	3/6/09	5.98	28.09	3/12/09	7	A	121000	4310	108
2	3/6/09	6.00	28.27	4/2/09	28	A	159080	5630	141
3	3/6/09	5.97	27.99	4/2/09	28	A	158720	5670	142
4	3/6/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Karin Lewis
Date: 4/2/09

Fracture Types





Job No: C09046
Test No: 7062

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	702846
Truck #:	153	Mix #:	-
Water Added (gals):	5	Load Size (cu yds):	9.50
Made by:	KJS of CGC	Date Made:	3/6/09
Specified Strength (psi):	3000	Specified Range (ins):	0-3.00
Slump (ins):	2.00	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	65		
Air Temp (deg f):	44		

Batched: 8:20

Delivered: 8:38

Unloaded: 9:00

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Interior Column Pads

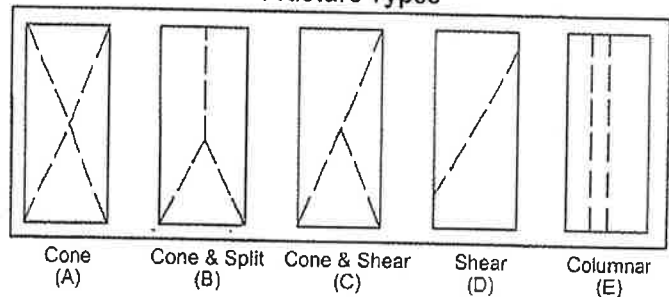
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	3/9/09	5.97	27.99	3/13/09	7	A	115990	4140	138
2	3/9/09	5.98	28.09	4/3/09	28	A	159270	5670	189
3	3/9/09	5.98	28.09	4/3/09	28	A	162160	5770	192
4	3/9/09	6.00	28.27	3/6/09	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis

Date: 4/7/09

Fracture Types





Job No: C09046
Test No: 7137

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	703964
Truck #:	215	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	8.75
Made by:	JCS of CGC	Date Made:	3/17/09
Specified Strength (psi):	3000	Specified Range (ins):	0-3.00
Slump (ins):	2.00	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	68		
Air Temp (deg f):	68		

Batched: 10:01

Delivered: 10:23

Unloaded: 10:40

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Footing Along Line C.8, 12.9-9.7 and Along Line 9.7, C.8-F.9

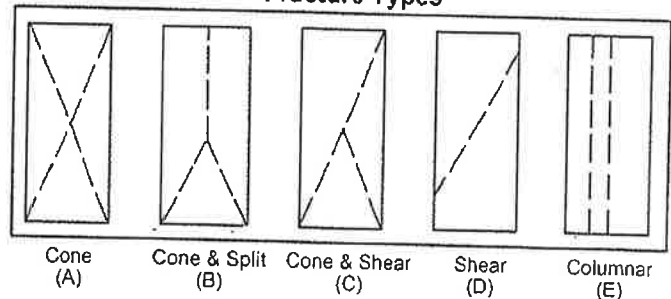
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	3/18/09	5.97	27.99	3/24/09	7	A	120800	4320	144
2	3/18/09	5.98	28.09	4/14/09	28	A	156900	5590	186
3	3/18/09	5.98	28.09	4/14/09	28	A	152760	5440	181
4	3/18/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis

Date: 4/15/09

Fracture Types





Job No: C09046
Test No: 7151

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedeusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedeusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	704252
Truck #:	79	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	0.75
Made by:	JCS of CGC	Date Made:	3/18/2009
Specified Strength (psi):	4000	Specified Range (ins):	2.00-4.00
Slump (ins):	3.50	Specified Range (%):	5-7
Air (%):	5.0	Specified Range (deg f):	50-90
Concrete Temp (deg f):	69		
Air Temp (deg f):	48		

Batched: 12:00 Delivered: 12:20 Unloaded: 12:45

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

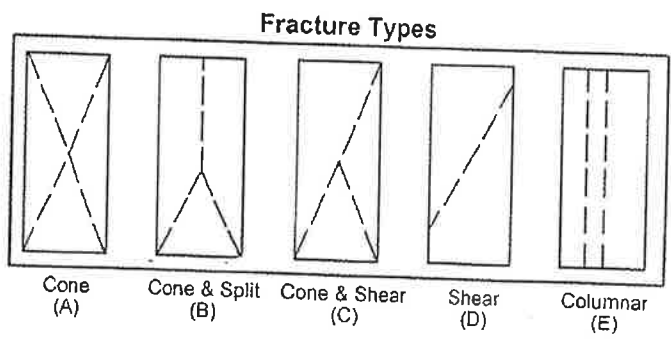
Test Data

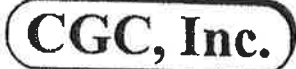
Location: Wall F9, 12.9-9.7

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	3/19/2009	6.00	28.27	3/25/2009	7	A	124070	4390	110
2	3/19/2009	5.99	28.18	4/15/2009	28	A	170340	6040	151
3	3/19/2009	6.00	28.27	4/15/2009	28	A	164830	5830	146
4	3/19/2009	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: *Kim Stearns*
Date: 7/16/09





Job No: C09046
Test No: 7369

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedeusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedeusch

Sampling Data

(Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	707126
Truck #:	92	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	JCS of CGC	Date Made:	4/10/09
Specified Strength (psi):	4000	Specified Range (ins):	2.00-4.00
Slump (ins):	3.50	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	74		
Air Temp (deg f):	34		

Batched: 6:26

Delivered: 7:07

Unloaded: 7:35

Design Weights

(According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Interior Slab-on-grade of Addition

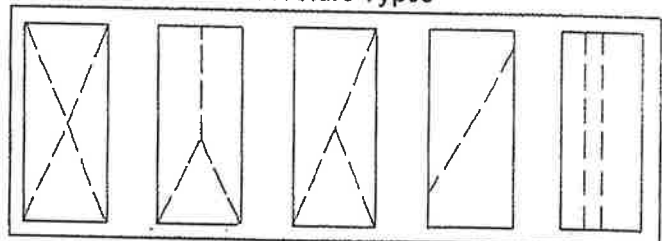
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/13/09	5.97	27.99	4/17/09	7	A	136410	4870	122
2	4/13/09	5.99	28.18	5/8/09	28	A	180410	6400	160
3	4/13/09	5.98	28.09	5/8/09	28	A	177170	6310	158
4	4/13/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Slawo

Date: 5/11/09

Fracture Types



Cone (A)

Cone & Split (B)

Cone & Shear (C)

Shear (D)

Columnar (E)



Job No: C09046
Test No: 7404

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	708141
Truck #:	214	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.25
Made by:	ECN of CGC	Date Made:	4/15/09
Specified Strength (psi):	4000	Specified Range (ins):	0-4.00
Slump (ins):	2.75	Specified Range (%):	5-7
Air (%):	5.4	Specified Range (deg f):	-
Concrete Temp (deg f):	67		
Air Temp (deg f):	54		

Batched: 9:47 Delivered: 9:58 Unloaded: 10:18

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

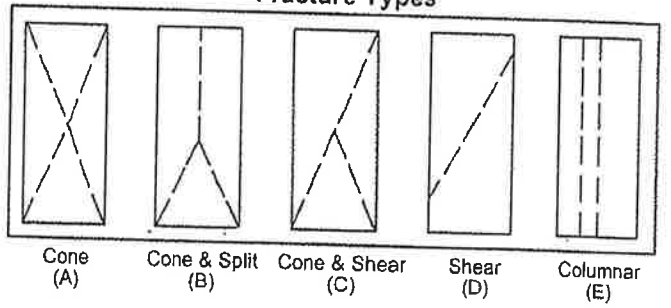
Location: Loading Dock Slab South Side Near Southwest Building Corner; Easternmost Quarter (9.25 of 160 cys)
(Set 1)

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/16/09	5.97	27.99	4/22/09	7	A	135030	4820	121
2	4/16/09	5.98	28.09	5/13/09	28	A	171940	6120	153
3	4/16/09	5.98	28.09	5/13/09	28	A	179240	6380	160
4	4/16/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis
Date: 5/14/09

Fracture Types



Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data

(Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	708175
Truck #:	150	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	ECN of CGC	Date Made:	4/15/09
Specified Strength (psi):	4000	Specified Range (ins):	0-4.00
Slump (ins):	3.50	Specified Range (%):	5-7
Air (%):	5.7	Specified Range (deg f):	-
Concrete Temp (deg f):	71		
Air Temp (deg f):	60		

Batched: 10:37

Delivered: 10:47

Unloaded: 11:15

Design Weights

(According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Loading Dock Slab South Side Near Southwest Building Corner; Easternmost Quarter (9.25 of 160 cys)
(Set 2)

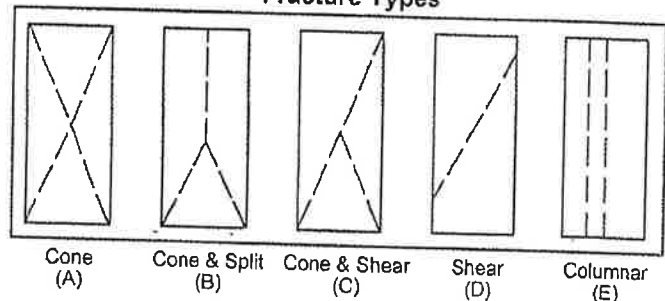
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/16/09	5.97	27.99	4/22/09	7	A	122070	4360	109
2	4/16/09	5.99	28.18	5/13/09	28	A	163530	5800	145
3	4/16/09	5.99	28.18	5/13/09	28	A	162800	5780	144
4	4/16/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis

Date: 5/14/09

Fracture Types





Job No: C09046
Test No: 7407

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	708270
Truck #:	3	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	JCS of CGC	Date Made:	4/15/09
Specified Strength (psi):	4000	Specified Range (ins):	0-4.00
Slump (ins):	4.25	Specified Range (%):	5-7
Air (%):	6.6	Specified Range (deg f):	50-90
Concrete Temp (deg f):	76		
Air Temp (deg f):	58		

Batched: 12:27 Delivered: 12:48 Unloaded: 1:15

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Loading Dock Southwest Corner at Building, West Sector (Set 4)

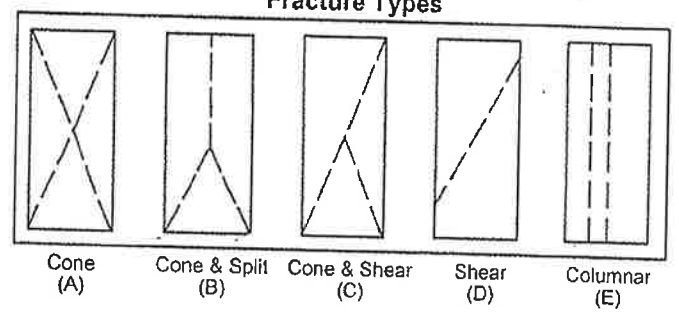
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/16/09	5.97	27.99	4/22/09	7	A	123450	4410	110
2	4/16/09	5.98	28.09	5/13/09	28	A	166510	5930	148
3	4/16/09	5.97	27.99	5/13/09	28	A	165630	5920	148
4	4/16/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Stein

Date: 5/14/09

Fracture Types





Job No: C09046
Test No: 7414

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data

(Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	708246
Truck #:	239	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	JCS of CGC	Date Made:	4/15/09
Specified Strength (psi):	4000	Specified Range (ins):	0-4.00
Slump (ins):	4.25	Specified Range (%):	5-7
Air (%):	6.3	Specified Range (deg f):	50-90
Concrete Temp (deg f):	74		
Air Temp (deg f):	58		

Batched: 12:08

Delivered: 12:30

Unloaded: 12:45

Design Weights

(According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Loading Dock Southwest Corner at Building, Middle West Section (Set 3)

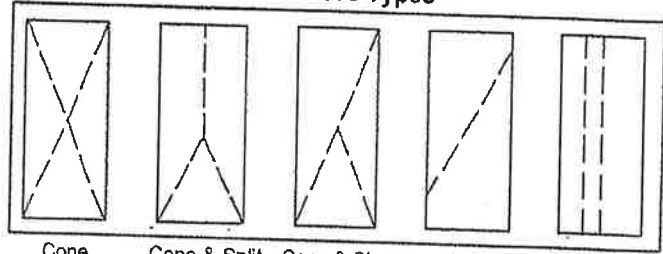
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/16/09	5.97	27.99	4/22/09	7	A	115040	4110	103
2	4/16/09	5.97	27.99	5/13/09	28	A	152260	5440	136
3	4/16/09	5.98	28.09	5/13/09	28	A	148710	5290	132
4	4/16/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: *Kim Klein*

Date: 5/14/09

Fracture Types



Cone (A) Cone & Split (B) Cone & Shear (C) Shear (D) Columnar (E)



Job No: C09046
Test No: 7513

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedeusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedeusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	709574
Truck #:	127	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	ZCJ of CGC	Date Made:	4/22/09
Specified Strength (psi):	4000	Specified Range (ins):	3.00-5.00
Slump (ins):	3.00	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	67		
Air Temp (deg f):	44		

Batched: 6:49

Delivered: 7:05

Unloaded: 7:20

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Slab-on-grade - Distribution Slab South of Drain - Set 1

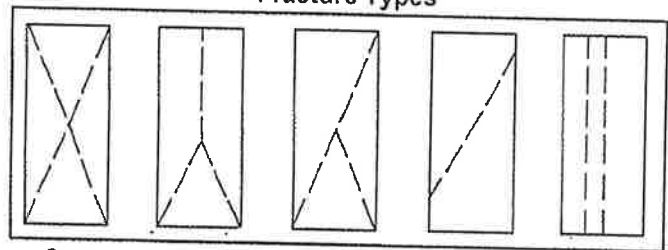
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/23/09	5.97	27.99	4/29/09	7	A	145830	5210	130
2	4/23/09	5.98	28.09	5/20/09	28	A	176410	6280	157
3	4/23/09	5.97	27.99	5/20/09	28	A	173790	6210	155
4	4/23/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kevin Lewis

Date: 5/20/09

Fracture Types



Cone (A)

Cone & Split (B)

Cone & Shear (C)

Shear (D)

Columnar (E)



Job No: C09046
Test No: 7514

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	709622
Truck #:	150	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	ZCJ of CGC	Date Made:	4/22/09
Specified Strength (psi):	4000		
Slump (ins):	5.50	Specified Range (ins):	3.00-5.00
Air (%):	-	Specified Range (%):	-
Concrete Temp (deg f):	65	Specified Range (deg f):	50-90
Air Temp (deg f):	40		

Batched: 7:30 Delivered: 7:50 Unloaded: 8:15

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

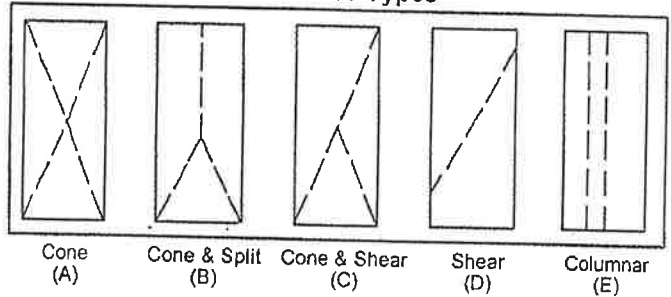
Location: Slab-on-grade Distribution Slab South of Drain - Set 2

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/23/09	5.99	28.18	4/29/09	7	A	144100	5110	128
2	4/23/09	5.98	28.09	5/20/09	28	A	171180	6090	152
3	4/23/09	5.98	28.09	5/20/09	28	A	178180	6340	159
4	4/23/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Stevia
Date: 5/20/09

Fracture Types





Job No: C09046
Test No: 7515

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	709677
Truck #:	150	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	BEF of CGC	Date Made:	4/22/09
Specified Strength (psi):	4000	Specified Range (ins):	3.00-5.00
Slump (ins):	4.00	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	58		
Air Temp (deg f):	44		

Batched: 8:36 Delivered: 8:45 Unloaded: 9:12

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

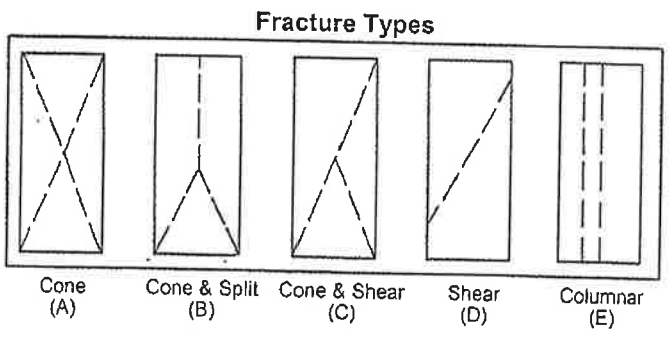
Test Data

Location: Slab-on-grade - Distribution Slab South of Drain - Set 3

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/23/09	5.97	27.99	4/29/09	7	A	143120	5110	128
2	4/23/09	5.97	27.99	5/20/09	28	A	166850	5960	149
3	4/23/09	5.98	28.09	5/20/09	28	A	178280	6350	159
4		6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis
Date: 5/25/09





Job No: C09046
Test No: 7516

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	709726
Truck #:	64	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	BEF of CGC	Date Made:	4/22/09
Specified Strength (psi):	4000	Specified Range (ins):	3.00-5.00
Slump (ins):	3.75	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	60		
Air Temp (deg f):	46		

Batched: 9:29

Delivered: 9:41

Unloaded: 11:05

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Slab-on-grade - Distribution Slab South of Drain - Set 4

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/23/09	5.99	28.18	4/29/09	7	A	141400	5020	125
2	4/23/09	5.98	28.09	5/20/09	28	A	167750	5970	149
3	4/23/09	5.97	27.99	5/20/09	28	A	170030	6070	152
4	4/23/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

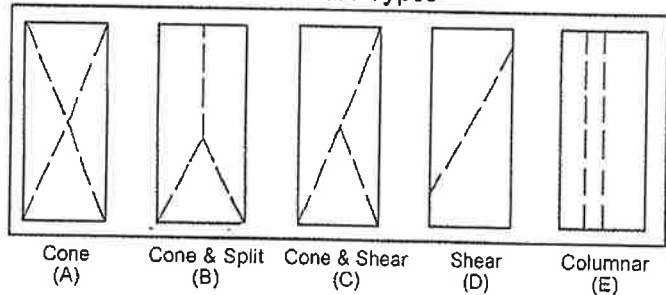
Signature: _____

Kim Stearns

Date: _____

5/20/09

Fracture Types





Job No: C09046
Test No: 7528

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	-
Truck #:	-	Mix #:	-
Water Added (gals):	5	Load Size (cu yds):	7.00
Made by:	RDC - Contractor	Date Made:	4/23/2009
Specified Strength (psi):	3500		
Slump (ins):	5.00	Specified Range (ins):	0-5.00
Air (%):	6	Specified Range (%):	4.5-7.5
Concrete Temp (deg f):	-	Specified Range (deg f):	-
Air Temp (deg f):	60		

Batched: - Delivered: - Unloaded: -

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

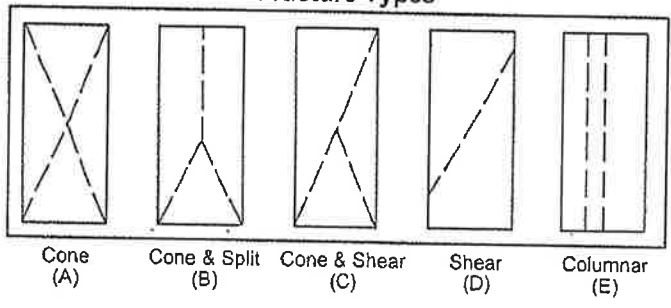
Location: Office Facia Panels OW4, OW5, OW6

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/24/2009	5.98	28.09	4/30/2009	7	A	96280	3430	98
2	4/24/2009	5.97	27.99	5/7/2009	14	A	118420	4230	121
3	4/24/2009	5.97	27.99	5/21/2009	28	A	139250	4970	142
4	4/24/2009	5.98	28.09	5/21/2009	28	A	131190	4670	133

Comments:

Signature: Kim Lewis
Date: 5/22/09

Fracture Types





Job No: C09046
Test No: 7554

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	710526
Truck #:	72	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	ZCJ of CGC	Date Made:	4/24/09
Specified Strength (psi):	4000	Specified Range (ins):	2.00-4.00
Slump (ins):	3.50	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	62		
Air Temp (deg f):	50		

Batched: 6:38 Delivered: 6:56 Unloaded: 7:10

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Slab-on-grade - Distribution Slab North of Drain

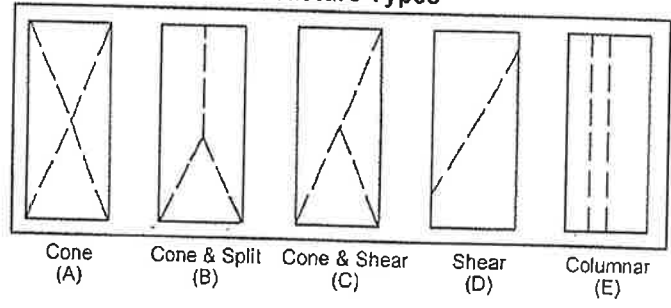
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/27/09	5.98	28.09	5/1/09	7	A	137470	4890	122
2	4/27/09	5.98	28.09	5/22/09	28	A	174510	6210	155
3	4/27/09	5.99	28.18	5/22/09	28	A	169900	6030	151
4		6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Stearns

Date: 5/26/09

Fracture Types





Job No: C09046
Test No: 7555

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	710571
Truck #:	134	Mix #:	-
Water Added (gals):	5	Load Size (cu yds):	9.50
Made by:	ZCJ of CGC	Date Made:	4/24/09
Specified Strength (psi):	4000	Specified Range (ins):	2.00-4.00
Slump (ins):	4.00	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	60		
Air Temp (deg f):	50		

Batched: 7:25

Delivered: 7:41

Unloaded: 8:05

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Slab-on-grade - Distribution Slab North of Drain (Set 2)

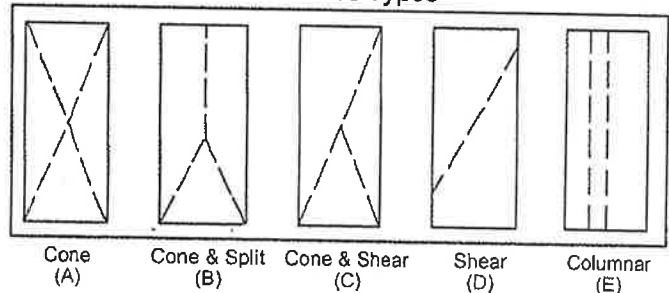
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/27/09	5.97	27.99	5/1/09	7	A	133810	4780	120
2	4/27/09	5.98	28.09	5/22/09	28	A	163940	5840	146
3	4/27/09	5.97	27.99	5/22/09	28	A	164260	5870	147
4	4/27/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Stearns

Date: 5/26/09

Fracture Types





Job No: C09046
Test No: 7556

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	710669
Truck #:	2	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.50
Made by:	ZCJ of CGC	Date Made:	4/24/09
Specified Strength (psi):	4000	Specified Range (ins):	2.00-4.00
Slump (ins):	4.50	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	50-90
Concrete Temp (deg f):	63		
Air Temp (deg f):	60		

Batched: 9:11 Delivered: 9:28 Unloaded: 9:35

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

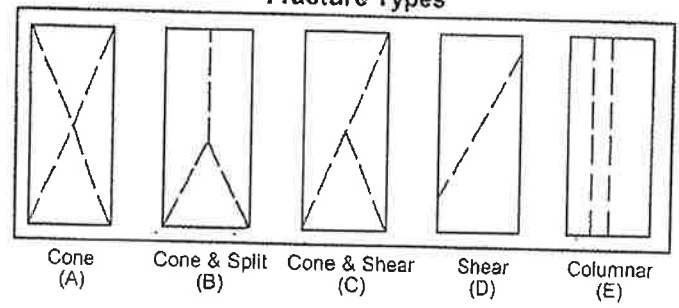
Location: Slab-on-grade - Distribution Slab North of Drain (Set 3)

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/27/09	5.98	28.09	5/1/09	7	A	133570	4760	119
2	4/27/09	6.00	28.27	5/22/09	28	A	169160	5980	150
3	4/27/09	5.99	28.18	5/22/09	28	A	169250	6010	150
4	4/27/09	6.00	28.27	4/24/09	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis
Date: 5/26/09

Fracture Types



Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	-
Truck #:	-	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	7.00
Made by:	RDC - Contractor	Date Made:	4/28/09
Specified Strength (psi):	3500	Specified Range (ins):	4.00-5.00
Slump (ins):	4.50	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	-
Concrete Temp (deg f):	-		
Air Temp (deg f):	60		

Batched: - Delivered: - Unloaded: -

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Structural Panels OW4, OW5, OW6

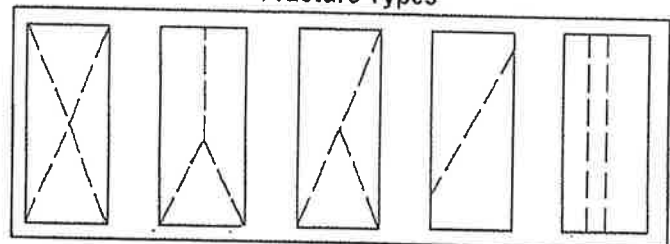
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/25/09	5.97	27.99	5/4/09	6	A	151770	5420	155
2	4/25/09	5.98	28.09	5/5/09	7	A	141190	5030	144
3	4/25/09	5.98	28.09	5/26/09	28	A	183980	6550	187
4	4/25/09	5.97	27.99	5/26/09	28	A	171060	6110	175

Comments:

Signature: Kim Stearn

Date: 5/27/09

Fracture Types



Cone (A) Cone & Split (B) Cone & Shear (C) Shear (D) Columnar (E)



Job No: C09046
Test No: 7626

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	712325
Truck #:	229	Mix #:	-
Water Added (gals):	4	Load Size (cu yds):	3.50
Made by:	RDC - Contractor	Date Made:	4/29/09
Specified Strength (psi):	3500		
Slump (ins):	5.00	Specified Range (ins):	0-5.00
Air (%):	6	Specified Range (%):	0-6
Concrete Temp (deg f):	-	Specified Range (deg f):	-
Air Temp (deg f):	55		

Batched: 1:29

Delivered: 1:45

Unloaded: 1:51

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

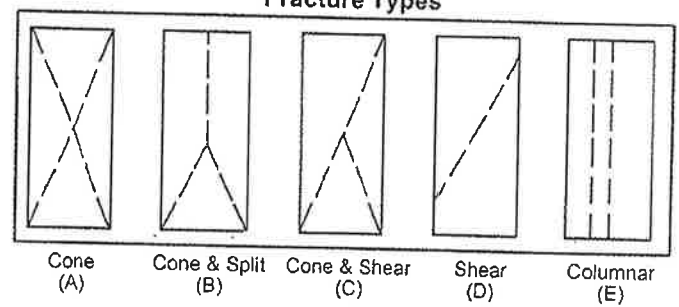
Location: Facia Panels on 8 and on 9

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	4/30/09	5.97	27.99	5/4/09	5	A	95520	3410	97
2	4/30/09	5.98	28.09	5/6/09	7	A	103500	3680	105
3	4/30/09	5.99	28.18	5/27/09	28	A	132720	4710	135
4	4/30/09	5.99	28.18	5/27/09	28	A	135420	4810	137

Comments:

Signature: Kim Stearns
Date: 5/28/09

Fracture Types





Job No: C09046
Test No: 7656

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	-
Truck #:	-	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	7.25
Made by:	RDC - Contractor	Date Made:	5/1/09
Specified Strength (psi):	3500		
Slump (ins):	4.00	Specified Range (ins):	3.00-5.00
Air (%):	-	Specified Range (%):	-
Concrete Temp (deg f):	-	Specified Range (deg f):	50-90
Air Temp (deg f):	60		

Batched: - Delivered: - Unloaded: -

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

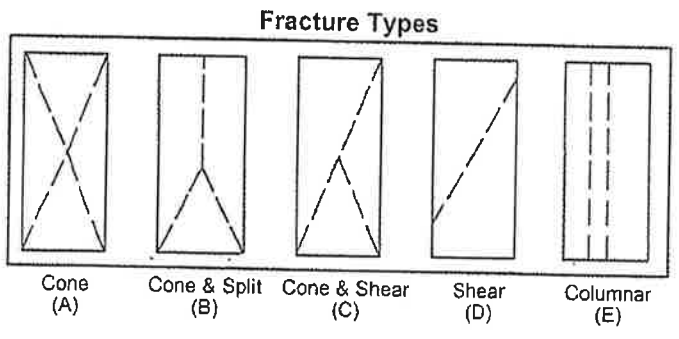
Test Data

Location: Structural Panel on 8 and on 9

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	5/4/09	5.99	28.18	5/8/09	7	A	146360	5190	148
2	5/4/09	6.00	28.27	5/29/09	28	A	182990	6470	185
3	5/4/09	6.02	28.46	5/29/09	28	A	173530	6100	174
4	5/4/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis
Date: 6/1/09





Job No: C09046
Test No: 7983

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedeusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedeusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	719547
Truck #:	25	Mix #:	-
Water Added (gals):	2	Load Size (cu yds):	8.00
Made by:	ZCJ of CGC	Date Made:	5/20/09
Specified Strength (psi):	4000		
Slump (ins):	3.00	Specified Range (ins):	2.00-4.00
Air (%):	6.6	Specified Range (%):	4.5-7.5
Concrete Temp (deg f):	74	Specified Range (deg f):	50-90
Air Temp (deg f):	70		

Batched: 12:04

Delivered: 12:18

Unloaded: 12:23

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Curb and Gutter Southwest Side Lot 1 - First 100'

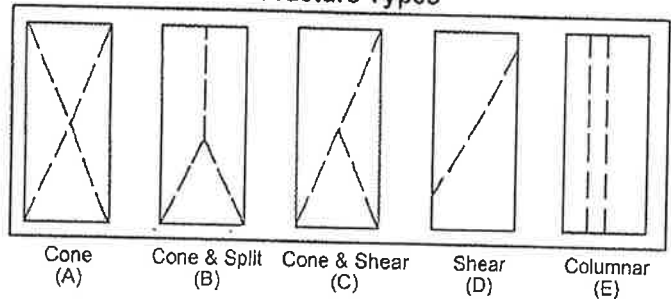
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	5/21/09	5.99	28.18	5/27/09	7	A	103090	3660	91
2	5/21/09	5.98	28.09	6/17/09	28	A	124490	4430	111
3	5/21/09	5.98	28.09	6/17/09	28	A	129830	4620	116
4	5/21/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kun Dawson

Date: 6/18/09

Fracture Types





Job No: C09046
Test No: 8003

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	719918
Truck #:	127	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	5.50
Made by:	MLL of CGC	Date Made:	5/21/09
Specified Strength (psi):	4000		
Slump (ins):	3.00	Specified Range (ins):	2.00-4.00
Air (%):	5.9	Specified Range (%):	4.5-7.5
Concrete Temp (deg f):	68	Specified Range (deg f):	50-90
Air Temp (deg f):	70		

Batched: 8:16

Delivered: 8:29

Unloaded: 8:45

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Curb and Gutter, Lot 1, Between Doors 58 and 59 of D.C

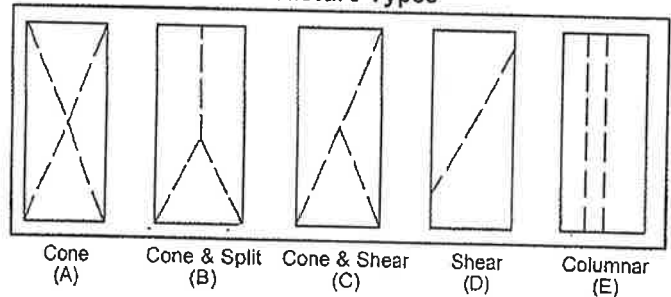
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	5/22/09	5.99	28.18	5/28/09	7	A	107550	3820	95
2	5/22/09	5.99	28.18	6/18/09	28	A	145170	5150	129
3	5/22/09	5.98	28.09	6/18/09	28	A	140660	5010	125
4	5/22/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis

Date: 6/22/09

Fracture Types





Job No: C09046
Test No: 8040

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data

(Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	720512
Truck #:	133	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	7.25
Made by:	MLL of CGC	Date Made:	5/22/09
Specified Strength (psi):	4000	Specified Range (ins):	2.00-4.00
Slump (ins):	3.00	Specified Range (%):	4.5-7.5
Air (%):	5.2	Specified Range (deg f):	50-90
Concrete Temp (deg f):	70		
Air Temp (deg f):	65		

Batched: 8:15

Delivered: 8:48

Unloaded: 8:51

Design Weights

(According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Curb and Gutter Lot 1 Between Doors 59 and 60 to End of Building - 105' Long

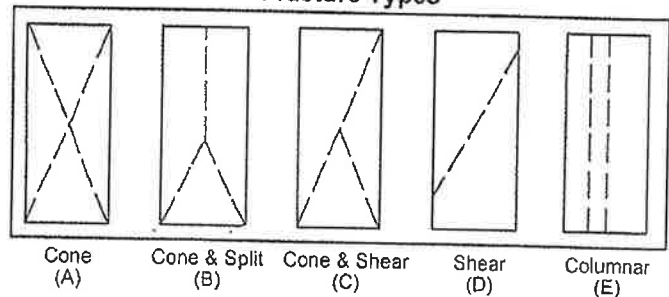
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	5/26/09	5.98	28.09	5/29/09	7	A	117610	4190	105
2	5/26/09	6.00	28.27	6/19/09	28	A	151140	5350	134
3	5/26/09	6.00	28.27	6/19/09	28	A	146780	5190	130
4	5/26/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis

Date: 6/22/09

Fracture Types





Job No: C09046
Test No: 8057

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	-
Truck #:	-	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	-
Made by:	Contractor	Date Made:	5/26/09
Specified Strength (psi):	-	Specified Range (ins):	-
Slump (ins):	-	Specified Range (%):	-
Air (%):	-	Specified Range (deg f):	-
Concrete Temp (deg f):	-		
Air Temp (deg f):	62		

Batched: - Delivered: - Unloaded: -

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

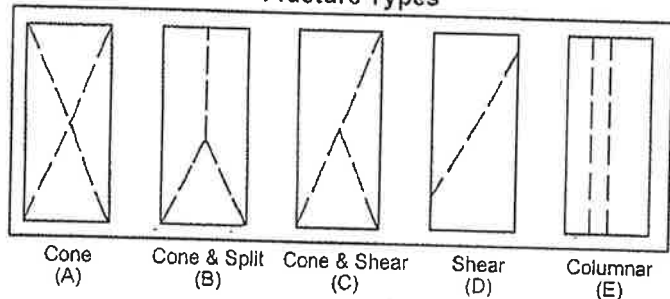
Location: Sidewalk, Curb and Gutter, Dolly Pad

Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	5/27/09	5.99	28.18	6/2/09	7	A	120640	4280	
2	5/27/09	5.99	28.18	6/23/09	28	A	140760	5000	
3	5/27/09	6.00	28.27	6/23/09	28	A	142550	5040	

Comments:

Signature: Kim Lewis
Date: 6/24/09

Fracture Types





Job No: C09046
Test No: 8076

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data (Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	721712
Truck #:	33	Mix #:	-
Water Added (gals):	4	Load Size (cu yds):	7.00
Made by:	MLL of CGC	Date Made:	5/28/09
Specified Strength (psi):	4000	Specified Range (ins):	3.00-5.00
Slump (ins):	3.25	Specified Range (%):	4.5-7.5
Air (%):	4.7	Specified Range (deg f):	50-90
Concrete Temp (deg f):	70		
Air Temp (deg f):	65		

Batched: 11:45

Delivered: 12:40

Unloaded: 12:42

Design Weights (According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Lot 1 Dolly Pads, Last 100' North of Door 60

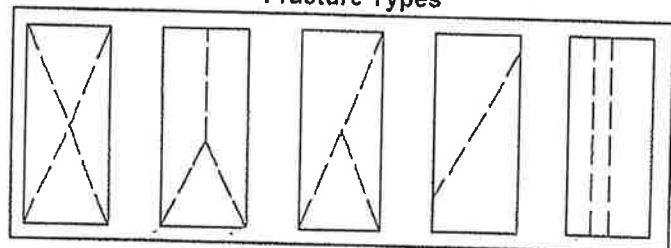
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	5/29/09	5.98	28.09	6/4/09	7	A	115380	4110	103
2	5/29/09	5.99	28.18	6/25/09	28	A	145430	5160	129
3	5/29/09	5.98	28.09	6/25/09	28	A	136390	4860	121
4	5/29/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim J Lewin

Date: 6/25/09

Fracture Types



Cone (A)

Cone & Split (B)

Cone & Shear (C)

Shear (D)

Columnar (E)

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@execpc.com

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data

(Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	725951
Truck #:	150	Mix #:	-
Water Added (gals):	5	Load Size (cu yds):	8.25
Made by:	MLL of CGC	Date Made:	6/9/09
Specified Strength (psi):	4000		
Slump (ins):	3.00	Specified Range (ins):	2.00-4.00
Air (%):	5.6	Specified Range (%):	4.5-7.5
Concrete Temp (deg f):	70	Specified Range (deg f):	50-90
Air Temp (deg f):	70		

Batched: 10:39

Delivered: 11:01

Unloaded: 11:08

Design Weights

(According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Curb and Gutter: New 28' Trailer Parking - 17 Spaces - Southeast Corner

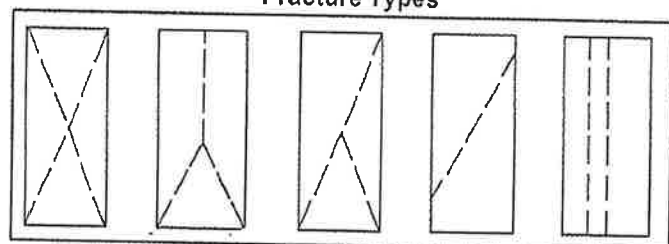
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	6/10/09	6.00	28.27	6/16/09	7	A	117020	4140	103
2	6/10/09	6.00	28.27	7/7/09	28	A	137910	4880	122
3	6/10/09	6.00	28.27	7/7/09	28	A	139450	4930	123
4	6/10/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Lewis

Date: 2/11/09

Fracture Types



Cone (A)

Cone & Split (B)

Cone & Shear (C)

Shear (D)

Columnar (E)



Job No: C09046
Test No: 8255

Concrete Test Report

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: 608/288-4100 Fax: 608/288-7887 E Mail: cgc@cgcinet.net

Project: Fed Ex Ground - Madison

To: Ruedebusch Dev. & Construction
4605 Dovetail Drive
Madison, WI 53704

CC: 1-Client, 1-File

Attn: Mr. Mike Ruedebusch

Sampling Data

(Field tests performed by CGC were done using applicable ASTM standards)

Supplier:	Lycon	Ticket #:	726466
Truck #:	211	Mix #:	-
Water Added (gals):	-	Load Size (cu yds):	9.25
Made by:	JCS of CGC	Date Made:	6/10/09
Specified Strength (psi):	4000	Specified Range (ins):	2.00-4.00
Slump (ins):	4.25	Specified Range (%):	4.5-7.5
Air (%):	4.6	Specified Range (deg f):	50-90
Concrete Temp (deg f):	79		
Air Temp (deg f):	68		

Batched: 11:30

Delivered: 12:00

Unloaded: 12:20

Design Weights

(According to supplier submittal)

1-1/2" Aggregate (lbs):	-	Water (lbs):	-
3/4" Aggregate (lbs):	-	Fly Ash (lbs):	-
3/8" Aggregate (lbs):	-	Water Reducer (oz/CWT):	-
Fine Aggregate (lbs):	-	Superplasticizer (oz/CWT):	-
Cement (lbs):	-	Air Ent Agent (oz/CWT):	-
		Other Admix (oz/CWT):	-

Test Data

Location: Dolly Path - East Side of Existing Building

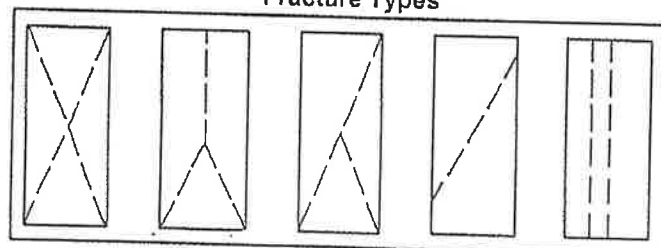
Cyl #	Received	Dia (ins)	Area (sq ins)	Test date	Age	Fracture	Load (lbs)	Unit Load (psi)	% Spec
1	6/11/09	5.99	28.18	6/17/09	7	A	96180	3410	85
2	6/11/09	6.00	28.27	7/8/09	28	A	135510	4790	120
3	6/11/09	5.99	28.18	7/8/09	28	A	133270	4730	118
4	6/11/09	6.00	28.27	-	-	Hold	-	-	-

Comments: Hold cylinder will be discarded if the 28 day break is above the specified strength.

Signature: Kim Stevin

Date: 7/10/09

Fracture Types



Cone (A)

Cone & Split (B)

Cone & Shear (C)

Shear (D)

Columnar (E)



RECEIVED
JUN 23 2009

Date: June 22, 2009
Project No.: C09131-1

TO: Ruedeusch Development
ADDRESS: 4605 Dovetail Drive
Madison, WI 53704
ATTN: Mr. Jeff Ruedeusch

TRANSMITTAL LETTER

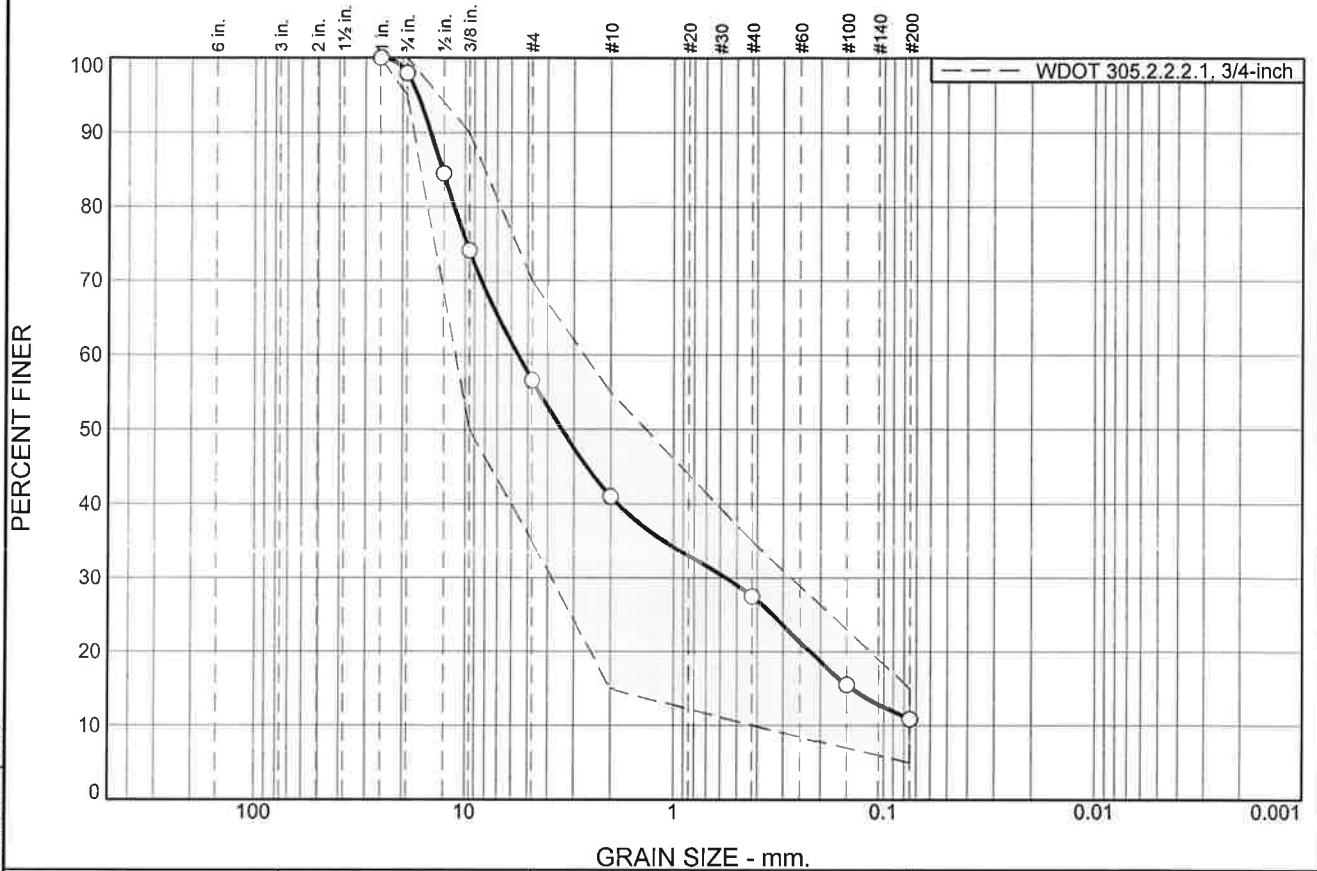
- Enclosed
- Under Separate Cover
- Messenger
- First Class Mail
- Special Delivery
- Air Mail
- Copy of Letter
- Prints
- Photos
- Specifications
- Samples
- _____
- Drilling Logs
- Test Results
- Documents
- Purchase Order
- For Your Use
- As Requested
- Approved
- Approved as Noted
- Resubmit
- Return Corrected Prints
- For Comments
- _____

No. of Copies	DESCRIPTION	DATE
1	Particle Size Distribution Report	06-11-09

REMARKS: _____

From: *Kim J Lewis*
Kim J Lewis
CGC, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.0	41.4	15.6	13.5	16.6	10.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.0"	100.0	100.0 - 100.0	
3/4"	98.0	95.0 - 100.0	
1/2"	84.4		
3/8"	74.1	50.0 - 90.0	
#4	56.6	35.0 - 70.0	
#10	41.0	15.0 - 55.0	
#40	27.5	10.0 - 35.0	
#100	15.6		
#200	10.9	5.0 - 15.0	

Material Description

Lt Brown Fine to Coarse Sand and Gravel, Little Silt (crushed limestone)

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 14.6461 D₈₅= 12.8959 D₆₀= 5.5647
D₅₀= 3.4302 D₃₀= 0.5633 D₁₅= 0.1403
D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Test No.8302

* WDOT 305.2.2.2.1, 3/4-inch

Source of Sample: Yahara - Hwy 51
Sample Number: 3/4 CABC 6-11-09

Date: 6-11-09



Client: Ruedebusch Development & Construction
Project: FedEx

Project No: C09131-1

Figure

Tested By: MAS

Checked By: KJL

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

CGC, Inc.

BITUMINOUS MIXTURE
TEST REPORT

Test No. 7905
Job No. C09046
Date June 23, 2009
Sheet 1 of 2

CGC, Inc. • 2921 Perry Street, Madison, WI 53713 • Tel. 608/288-4100 • FAX 608/288-7887

Project: FedEx Ground
Madison, Wisconsin

SAMPLE LOCATIONS:
(1) Plant Sample
60 tons

To: Ruedebusch Development & Construction
4605 Dovetail Drive
Verona, WI 53593

Attention: Mr. Mike Ruedebusch

cc:

Material: E-1, 19.0 mm (807408)
Supplier: Payne & Dolan - Vienna

Date Sampled: 06-11-09
Date Received: 06-11-09
Sampled by: P & D

BITUMINOUS MIXTURE EXTRACTION		
Sieve Size	Percent Finer by Weight	
	Sample 1	Formula Limits
1 in.	100.0	-
3/4 in.	99.5	-
1/2 in.	87.3	-
3/8 in.	78.0	-
#4	61.2	-
#8	47.9	-
#16	38.3	-
#30	30.4	-
#50	14.4	-
#100	6.0	-
#200	4.0	-
Maximum Specific Gravity (ASTM D-2041)	2.504	-
Bulk Specific Gravity	2.418	-
Percent Air Voids	3.4	-
VMA (%)	-	-

Remarks: Tests performed at CGC's laboratory by K. Lewis.

SIGNATURE: Kim Lewis

Date: 6/23/09



BITUMINOUS MIXTURE TEST REPORT

Test No. 7905
 Job No. C09046
 Date June 23, 2009
 Sheet 2 of 2

CGC, Inc. • 2921 Perry Street, Madison, WI 53713 • Tel. 608/288-4100 • FAX 608/288-7887

Project: FedEx Ground
 Madison, Wisconsin

SAMPLE LOCATIONS:

(1) Plant Sample

To: Ruedebusch Development & Construction
 4605 Dovetail Drive
 Verona, WI 53593

Attention: Mr. Mike Ruedebusch

cc:

Material: E-1, 12.5 mm (807108)
Supplier: Payne & Dolan - Vienna

Date Sampled: 06-11-09

Date Received: 06-11-09

Sampled by: P & D

BITUMINOUS MIXTURE EXTRACTION		
Sieve Size	Percent Finer by Weight	
	Sample 1	Formula Limits
1 in.	100.0	-
3/4 in.	100.0	-
1/2 in.	96.3	-
3/8 in.	86.6	-
#4	64.1	-
#8	49.4	-
#16	39.5	-
#30	30.9	-
#50	12.7	-
#100	4.2	-
#200	2.8	-
Maximum Specific Gravity (ASTM D-2041)	2.499	-
Bulk Specific Gravity	2.401	-
Percent Air Voids	3.9	-
VMA (%)	-	-

Remarks: Tests performed at CGC's laboratory by K. Lewis.

SIGNATURE: Kim Lewis

Date: 6/23/09

<div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block;"> CGC, Inc. </div>	Bituminous Mixture Extraction	Test No. 7890 Job No. C09046 Date 6/23/09 Sheet 1 of 1
--	--	---

CGC, Inc. 2921 Perry Street Madison, WI 53713 Phone: (608) 288-4100 Fax: (608) 288-7887

Project: FedEx Parking Lot
Madison, WI

Sample Locations:

- (1) Sample from SE Corner
Older Lot

To: Ruedebusch Development & Construction
4605 Dovetail Dr.
Madison, WI 53704

Attention: Mr. Mike Ruedebusch

cc:

Material: Lower Layer
Supplier: Frank Bros.
Mix Temp. (deg F) (1)

Date Sampled: 6/11/2009
Date Received: 6/11/2009
Sampled By: KJL of CGC

Bituminous Mixture Extraction		
Sieve Size	Percent Finer by Weight	
	Sample 1	Job Formula
1 1/2 in.	100.0	
1 in.	100.0	
3/4 in.	98.4	
1/2 in.	93.0	
3/8 in.	83.2	
#4	69.6	
#8	52.8	
#16	43.1	
#30	33.9	
#50	16.3	
#200	7.3	
% Bitumen	5.5	

Comments: Thickness of pavemet layer is 3.0 inches

Signature: Kevin Slawin

Date: 6/23/09

RECEIVED

MAR 27 2009

COPY

Mr. Mike Ruedebusch
Ruedebusch Development & Construction
4605 Dovetail Drive
Madison, Wisconsin 53704

Re: Field Report No. 1
FedEx Expansion
Madison, Wisconsin

Dear Mr. Ruedebusch:

This report summarizes testing services conducted by CGC staff at the above-referenced project on an intermittent basis between March 2, 2009 and March 18, 2009. During our twelve site visits, which were arranged by your firm, we observed footing subgrade soil conditions, observed proof-rolls of the south loading dock area as well as the warehouse interior slab subgrade, performed field density tests (FDTs) on compacted fill and conducted field testing on concrete delivered to the site. The following paragraphs discuss our observations in more detail.

SUBGRADE OBSERVATIONS

During our site visits on March 2, 3, 5 and 16, we observed soil subgrade conditions at the base of perimeter and interior footing excavations for the warehouse expansion as well as perimeter footings for the office addition. (See attached Table 1). In general, we observed natural granular soils at the base of the excavations.

We expressed our opinion that the observed soil subgrade conditions appeared satisfactory for foundations proportioned for an allowable soil bearing pressure of 3500 psf. This opinion is based on our visual observations, rod probe penetrations (using a 5/8-in. diameter hand-held steel rod) performed at or near footing grade, as well as soil boring information contained in the geotechnical report prepared for this project (see CGC Report No. C03164 dated July 23, 2003 not attached).

PROOF-ROLL OBSERVATIONS

CGC personnel observed a proof-roll during our site visit on March 17, 2009. The proof-roll was also observed by Mike Ruedebusch (Ruedebusch Development and Construction) and Jerry Kavon (Kavon Excavating). A loaded quad axle dump truck was used to perform the proof-roll of two areas. Area 1 is the south loading dock area (from grid C.8 to F.9 and south of grid 12.9). The area measured 130 ft x 50 ft. No deflection or rutting was observed in the area. CGC did recommend that a approximately 15 ft wide x 50 ft long area at the southwest corner of the loading dock area be "cleaned up" to remove approximately 6-in. of disturbed /muddy soils prior to placement of 6-in. of crushed stone.

Mr. Mike Ruedebusch
Ruedebusch Development & Construction
March 26, 2009
Page 2

Area 2 was the interior of the proposed warehouse expansion. This area is to receive a slab on grade. A proof-roll was requested to confirm the suitability of the existing grade prior to placement of 6-in. of ¾-in. gravel with fines. No deflection or rutting was observed in the area. In our opinion the observed subgrades are suitable for the support of the proposed reinforced concrete slab.

FIELD DENSITY TESTING

During one site visit, a total of three field density tests were performed within on-site granular soils placed as interior wall backfill. In general, the test results (attached) for the fill placed met the required 95% compaction level at the elevations and locations tested based on modified Proctor methods (ASTM D1557). Rod probe penetrations (using a handheld 5/8-in. diameter steel rod) typically ranged from 4 to 6 in. in the granular soils within the fill areas tested and adjacent non-tested areas, implying uniformity in the compaction process.

CONCRETE TESTING

During six site visits we conducted field testing (i.e., air, slump, temperature) on concrete delivered to the site to construct portions of the footings and foundation walls of the facility. The results of the field tests were generally within project specification limits. The field test results were submitted to on-site personnel after the tests were completed. During each site visit, one set of four cylinders was cast for compressive strength testing. The compressive strength test results for the concrete samples will be or have been submitted to you separately.

LABORATORY TESTING

A sample of fill from the site was returned to our laboratory to develop a modified Proctor curve (results attached). The maximum dry density information from the curve was/will be used to calculate in-place compaction values.



Mr. Mike Ruedebusch
Ruedebusch Development & Construction
March 26, 2009
Page 3

We trust this report addresses your present needs. If you have any questions, please contact us.

Sincerely,

CGC, Inc.

Kirk J. Solberg
Project Geologist

William W. Wuellner, P.E.
Senior Geotechnical Engineer

Encl: Table 1 – Footing Subgrade Observations
Field Density Test Report No. 1
Moisture Density Curve (1)

Table 1
Footings Subgrade Observations
FedEx Expansion
Madison, Wisconsin

Date	Location	Footings Bearing Soil Description	Rod Probe Penetrations, in.	Pocket Penetrometer Readings, ton/sq ft	Comments
South Perimeter Footing:					
3/2/09	From Existing Building West to Southwest Corner	Light Brown Fine to Medium Sand, Some Silt and Gravel	≤ 4	-	Recommended recompacting this layer. Sands loosened as a result of excavation. Satisfactory ⁽¹⁾ .
West Perimeter Footing:					
3/3/09	From Existing Building South to Southwest Corner	Light Brown Fine to Medium Sand, Some Silt and Gravel	≤ 4	-	Recommended recompacting this layer. Sands loosened as a result of excavation. Satisfactory ⁽¹⁾ .
3/5/09	Interior Column Pads at E-11, E-12, F-11 and F-12	Brown Fine Silty Sand and Gravel	2 - 4	-	Recommended recompaction of subgrade with hoe-pak following excavation. Satisfactory ⁽¹⁾ .
Perimeter Footings - Office Area Expansion:					
3/16/09	North Footing	Light Brown Fine to Medium sand, Some Silt and Gravel	≤ 4	-	Satisfactory ⁽¹⁾ .
3/16/09	West Footing	Light Brown Fine to Medium Sand, Some Silt and Gravel	≤ 6	-	Several small portions of footing subgrade comprised of clear stone used to backfill relocated utilities. Isolated areas with rod-probes to 8 in. Recommended recompaction. Satisfactory ⁽¹⁾ .

⁽¹⁾ Based on an allowable soil bearing pressure of 3,500 psf.

FIELD DENSITY TEST REPORT - NO. 1

CGC, Inc., 2921 Perry Street, Madison, WI 53713 - Phone (608) 288-4100 - Fax (608) 288-7887

PROJECT: FedEx Expansion
Madison, WI

TO: Ruedebusch Development & Construction
4605 Dovetail Drive
Madison, WI 53704

ATTN: Mr. Mike Ruedebusch

TEST METHODS: Moisture-density relationship of soils based on MODIFIED Proctor (ASTM D1557)
"METHOD" indicates: (N) Nuclear (ASTM D2922) or (S) Sand Cone (ASTM D1556)

Test No.	O	D	Location	Elevation (ft)	Distance (1) Below Surface (in)	Description of Material Tested	Moisture %	Dry	Maximum	Meas. Comp.	Spec. Comp.
								Density lb/cu ft	Density lb/cu ft		
<u>03-11-09</u>											
<u>Interior Wall Backfill</u>											
1	N		4'N, 29'E of Building Corner, F9/12.9	99	0	Orange Brown Fine to Medium Sand, Little Silt and Gravel	8.2	115.7	117	99%	95%
2	N		3'N, 52'E of Building Corner, F9/12.9	99	0	Orange Brown Fine to Medium Sand, Little Silt and Gravel	8.3	115.1	117	98%	95%
3	N		2'N, 5'E of Building Corner, F9/12.9	99	0	Orange Brown Fine to Medium Sand, Little Silt and Gravel	7.8	113.0	117	97%	95%

* Indicates measured compaction below specification.

Comments: (1) Test elevations are referenced to finish floor slab at EL 100.0' (assumed datum).

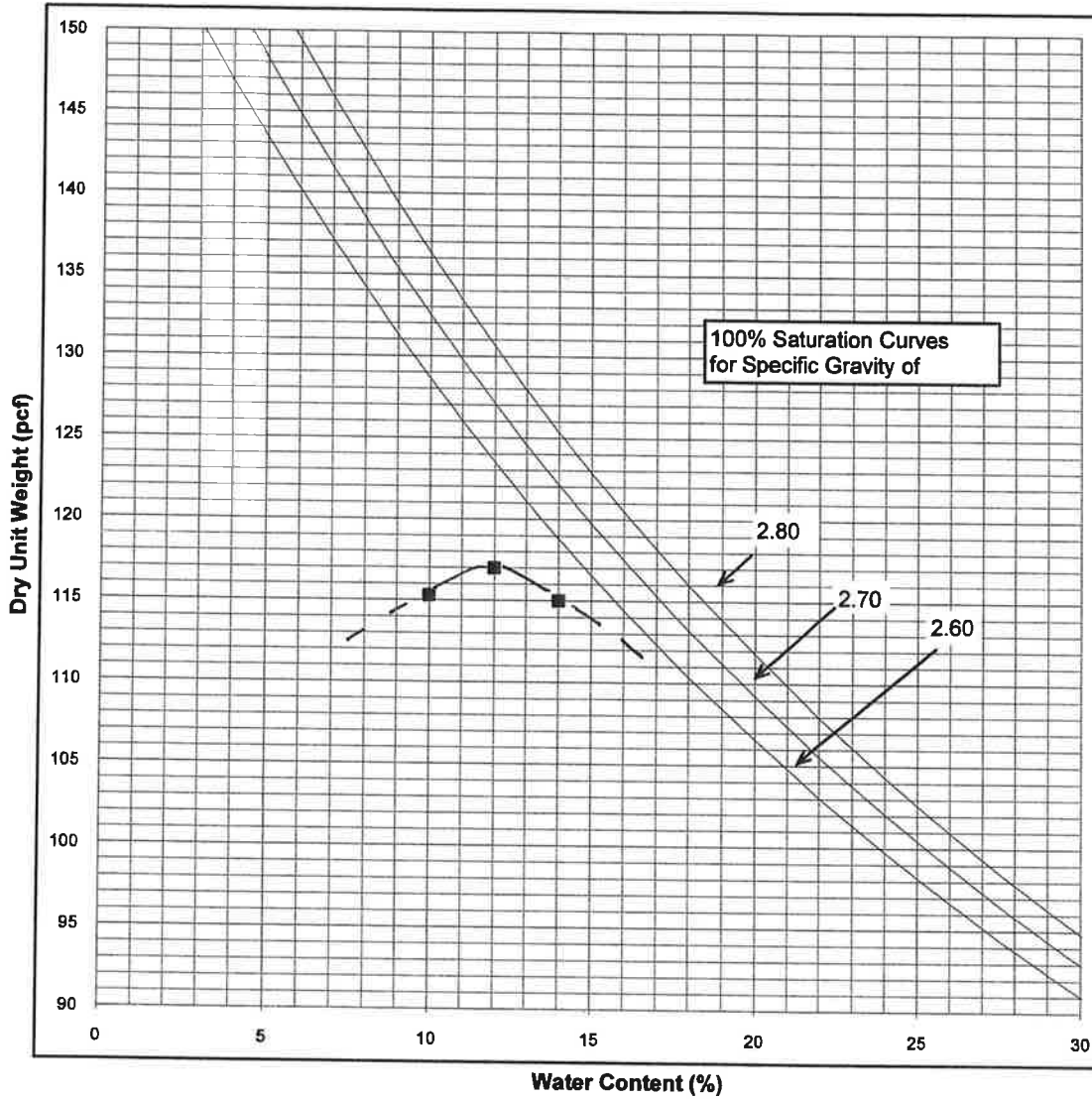
Signed


Kirk J. Solberg

Dated


3/25/09

TEST REPORT



Specimen No.	Maximum Dry Unit Weight, pcf	Optimum Water Content, %			
1	117.0	12.0			
Specimen Description					
Orange Brown Fine to Medium Sand, Little Silt and Gravel					
Corrected Maximum Dry Unit Weight, pcf	Corrected Optimum Water Content, %				
n/a	n/a				
Test Method	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity	
ASTM D1557-91, Method A	-	-	-	2.7 (est.)	
Preparation Method	USCS	% Gravel	% Sand	% Fines	% Oversize
Dry	SP-SM	11.1	-	-	-

PROJECT: FedEx Expansion
Madison, WI
PROJECT NUMBER: C09046

LABORATORY COMPACTION TEST

CGC, Inc.

CHECKED BY: MAS REVIEWED BY: MNS

11-Mar-09

CGC, INC.

TEST REPORT
FLEXURAL STRENGTH
OF CONCRETE
ASTM C78

Test No. 7594
Job No. C009046
Date May 6, 2009
Sheet 1 of 1

MAY 09 2009

CGC, Inc. . 2921 Perry Street . Madison, WI 53713 . Tel. 608/288-4100 . FAX 608/288-7887

DATE BEAMS CAST 04-28-09

PROJECT Fed Ex Ground - Madison

TO Ruedebusch Development and Construction

4605 Dovetail Drive

Madison, WI 53704

ATTENTION Mr. Mike Ruedebusch

COPIES TO 1-Client 1-File

SAMPLING DATA

CONCRETE SPECIFICATIONS

CONCRETE SUPPLIER Lycon

STRENGTH _____ PSI AT _____ DAYS

TICKET NUMBER _____

PORTLAND CEMENT _____ BAGS _____ LBS

WEATHER _____ WITH 60 °F AIR TEMP

WATER _____ GALS _____ LBS W/C _____

SLUMP 4.5 INCHES AIR _____ %

SLUMP RANGE 4-5 IN. AIR RANGE _____ %

CONCRETE TEMPERATURE _____

CONCRETE TEMPERATURE RANGE _____ °F

BEAMS MADE BY Contractor

DATE BEAMS RECEIVED 4-29-09

BEAM NO.	LOCATION	LAB CURE DAYS	TEST DATE	WIDTH IN.	DEPTH IN.	LENGTH IN.	MAX. LOAD LBS	AGE DAYS	STRENGTH PSI
1	Structural Panel 0W4, OW5 and OW6	2	05-01-09	6.07	6.03	18.0	5780	3	470
2		5	05-04-09	6.24	6.04	18.0	7280	6	575
3		5	05-04-09	6.11	6.04	18.0	8240	6	670

BATCH WEIGHTS PER CUBIC YARD

COARSE AGGREGATE 1 1/2" _____ LBS FLY ASH _____ BAGS _____ LBS

COARSE AGGREGATE 3/4" _____ LBS AIR ENTRAINING AGENT _____ OZ

FINE AGGREGATE _____ LBS WATER REDUCER _____ OZ

CEMENT _____ BAGS _____ LBS RETARDER _____

WATER _____ GALS. _____ LBS ACCELERATOR _____

COMMENTS _____

SIGNATURE

Kim Stewin

DATE

5/6/09

CGC, INC.

TEST REPORT FLEXURAL STRENGTH OF CONCRETE ASTM C78

Test No. 7680
Job No. C009046
Date May 6, 2009
Sheet 1 of 1

CGC, Inc. . 2921 Perry Street . Madison, WI 53713 . Tel. 608/288-4100 . FAX 608/288-7887

DATE BEAMS CAST 05-01-09

PROJECT Fed Ex Ground - Madison

TO Ruedebusch Development and Construction

4605 Dovetail Drive

Madison, WI 53704

ATTENTION Mr. Mike Ruedebusch

COPIES TO 1-Client 1-File

SAMPLING DATA

CONCRETE SUPPLIER Lycon

TICKET NUMBER _____

WEATHER _____ WITH 60 °F AIR TEMP

SLUMP 4.0 INCHES AIR _____ %

CONCRETE TEMPERATURE _____

BEAMS MADE BY Contractor

CONCRETE SPECIFICATIONS

STRENGTH _____ PSI AT _____ DAYS

PORTLAND CEMENT _____ BAGS _____ LBS

WATER _____ GALS _____ LBS W/C _____

SLUMP RANGE _____ IN. AIR RANGE _____ %

CONCRETE TEMPERATURE RANGE _____ °F

DATE BEAMS RECEIVED 05-04-09

BEAM NO.	LOCATION	LAB CURE DAYS	TEST DATE	WIDTH IN.	DEPTH IN.	LENGTH IN.	MAX. LOAD LBS	AGE DAYS	STRENGTH PSI
1	Structural Panels on 8 and 9	0	05-04-09	6.03	6.25	18.0	5380	3	440
2		0	05-04-09	6.12	6.06	18.0	4860	3	470
3		1	05-05-09	6.01	6.00	18.0	7660	4	620
4								Hold	

BATCH WEIGHTS PER CUBIC YARD

COARSE AGGREGATE 1 1/2" _____ LBS FLY ASH _____ BAGS _____ LBS

COARSE AGGREGATE 3/4" _____ LBS AIR ENTRAINING AGENT _____ OZ

FINE AGGREGATE _____ LBS WATER REDUCER _____ OZ

CEMENT _____ BAGS _____ LBS RETARDER _____

WATER _____ GALS _____ LBS ACCELERATOR _____

COMMENTS _____

SIGNATURE Kim Lewin DATE 5/6/09

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**SECTION 024119
 SELECTIVE DEMOLITION**

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PART 1 - GENERAL

- 25
 26 **1.1 SUMMARY**
 27 A. Section Includes:
 28 1. Demolition and removal of selected portions of building or structure.
 29 2. Demolition and removal of selected site elements.
 30 3. Salvage of existing items to be reused or recycled.
 31 B. Related Requirements:
 32 1. Section 017329 "Cutting and Patching" for cutting and patching procedures.
 33 2. Section 02 32 00 - Geotechnical Reports
 34 3. Section 31 20 00 – Earthmoving
 35 4. Section 31 25 00 - Erosion Control
 36 **1.2 DEFINITIONS**
 37 A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or
 38 reinstalled.
 39 B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
 40 C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse,
 41 and reinstall where indicated.
 42 D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be
 43 salvaged or reinstalled.
 44 **1.3 MATERIALS OWNERSHIP**
 45 A. Unless otherwise indicated, demolition waste becomes property of Contractor.
 46 B. Historic items and similar objects of interest or value to Owner that may be uncovered during demolition remain
 47 the property of Owner.
 48 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.
 49 **1.4 SUBMITTALS**
 50 A. For utilities or other services requiring removal or abandonment in-place, submit materials documenting
 51 completion of such work. Accurately record actual locations of capped utilities and subsurface obstructions that
 52 will remain after demolition.
 53 B. Submit record drawings.
 54 C. Submit copies of records documenting recycling or disposal of demolition materials from the site.
 55 D. Gradation test results for concrete excavated from the site and crushed on-site. Results shall be provided prior to
 56 placement as fill in areas shown in the Drawings.
 57 **1.5 INFORMATIONAL SUBMITTALS**
 58 A. Qualification Data: For refrigerant recovery technician.

- 1 B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for
2 protecting individuals and property for dust control. Indicate proposed locations and construction of barriers.
- 3 C. Schedule of Selective Demolition Activities: Indicate the following:
4 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each
5 activity. Ensure Owner's on-site operations are uninterrupted.
6 2. Interruption of utility services. Indicate how long utility services will be interrupted.
7 3. Coordination for shutoff, capping, and continuation of utility services.
8 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial
9 occupancy of completed Work.
- 10 D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces,
11 that might be misconstrued as damage caused by salvage and demolition operations. Submit before Work begins.
- 12 E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant,
13 stating that all refrigerant that was present was recovered and that recovery was performed according to EPA
14 regulations. Include name and address of technician and date refrigerant was recovered.
- 15 F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective
16 demolition.
- 17 **1.6 CLOSEOUT SUBMITTALS**
- 18 A. Inventory: Submit a list of items that have been removed and salvaged.
- 19 **1.7 QUALITY ASSURANCE**
- 20 A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- 21 **1.8 FIELD CONDITIONS**
- 22 A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective
23 demolition so Owner's operations will not be disrupted.
- 24 B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- 25 C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective
26 demolition.
- 27 D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
28 1. Hazardous materials will be removed by Owner before start of the Work.
29 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
30 Hazardous materials will be removed by Owner under a separate contract.
- 31 E. Storage or sale of removed items or materials on-site is not permitted.
- 32 F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during
33 selective demolition operations.
34 1. Maintain fire-protection facilities in service during selective demolition operations.
- 35 **1.9 PERMITS**
- 36 A. If necessary, file and maintain Notification of Demolition and/or Renovation and Application for Permit Exemption
37 (WDNR Form 4500-113) in accordance with the Wisconsin Administrative Code Chapter NR 447.
- 38 B. If necessary, obtain and maintain necessary WDNR air pollution permit(s) for operation of a crushing plant for the
39 recycling of concrete debris including all fees if concrete is crushed on-site.
- 40 **1.10 DISCONNECTION OF SERVICES**
- 41 A. Prior to starting removal and/or demolition operations be responsible and coordinate disconnection of all existing
42 utilities, communication systems, alarm systems, and other services.
- 43 B. Disconnect all services in manner which insures continued operation in facilities not scheduled for demolition.
- 44 C. Disconnect all services in manner which allows for future connection to that service.
- 45 D. Disconnect services to equipment at unions, flanges, valves, or fittings wherever possible.
- 46 **1.11 MILLING EXISTING PAVEMENT**
- 47 A. All work shall conform to Section 204.3 of the "Standard Specifications for Highway and Structure Construction"
48 Current Edition prepared by the State of Wisconsin Department of Transportation, except as modified.
- 49 **1.12 RECORD DRAWINGS**
- 50 A. Maintain record drawings showing actual locations of utilities and other features encountered, and any deviations
51 from the original design. Show actual limits of removal and demolition.
- 52 **1.13 SAFETY**
- 53 A. Verify, recording dates, times, contacts and contact information, that all gas and electrical utilities have been
54 abandoned or disconnected and associated hazards mitigated, prior to beginning any demolition.
- 55 B. Take all necessary precautions while dismantling piping containing gas, gasoline, oil or other explosive or toxic fluids
56 or gases. Purge lines and contain materials in accordance with all applicable regulations. Store such piping
57 outdoors until fumes are removed.

1 C. Hazardous materials are not anticipated. If encountered, terminate operations and contact the Owner's Project
2 Representative immediately. Follow all applicable local, state, and federal regulations pertaining to hazardous
3 materials.

4 **1.14 COORDINATION**

5 A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

6 **1.15 REMOVAL/SALVAGING OF ITEMS**

7 A. Carefully remove all items that are scheduled to be salvaged.

8 B. Where salvaged items are indicated to be turned over to the Owner, deliver to location on property where
9 designated by the Owner's Project Representative.

10 C. Where indicated to be incorporated into new work, store the salvaged item in secure location until trade
11 responsible for re-installation mobilizes his equipment and storage facilities to the site, or otherwise accepts
12 responsibility for the salvaged item.

13 **PART 2 - PRODUCTS**

14 **2.1 PERFORMANCE REQUIREMENTS**

15 A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective
16 demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

17 B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

18 C. Maintain the existing building structure, envelope, and interior nonstructural elements of an abandoned or blighted
19 building. Do not demolish such existing construction beyond indicated limits.

20 **2.2 EQUIPMENT**

21 A. Contractor shall supply and utilize equipment which meets or exceeds all safety requirements.

22 **2.3 FILL MATERIALS**

23 2.4 Backfill material for all on-site demolition shall consist of quality, on-site subsoil.

24 **PART 3 - EXECUTION**

25 **3.1 EXAMINATION**

26 A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

27 B. Review Project Record Documents of existing construction or other existing condition and hazardous material
28 information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in
29 Project Record Documents.

30 C. Perform an engineering survey of condition of building to determine whether removing any element might result in
31 structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective
32 building demolition operations.

33 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

34 D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

35 1. Inventory and record the condition of items to be removed and salvaged.

36 **3.2 PREPARATION**

37 A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and
38 regulations of authorities having jurisdiction.

39 **3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS**

40 A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against
41 damage.

42 B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off
43 utility services and mechanical/electrical systems serving areas to be selectively demolished.

44 1. Arrange to shut off utilities with utility companies.

45 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary
46 services/systems that bypass area of selective demolition and that maintain continuity of services/systems
47 to other parts of building.

48 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and
49 components indicated on Drawings to be removed.

50 a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining
51 piping with same or compatible piping material.

52 b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible
53 piping material and leave in place.

54 c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

55 d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and
56 store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

57 e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and
58 deliver to Owner.

- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.

1 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and
2 equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional
3 for use indicated.

4 E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective
5 demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during
6 selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are
7 complete.

8 **3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS**

9 A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least **3/4 inch** at
10 junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being
11 demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions
12 indicated.

13 B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven
14 saw, and then remove masonry between saw cuts.

15 C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

16 D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's
17 "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring
18 solvent-based adhesive strippers.

19 E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building
20 interior remains watertight and weathertight.

21 1. Remove existing roof membrane, flashings, copings, and roof accessories.

22 2. Remove existing roofing system down to substrate.

23 **3.7 DISPOSAL OF DEMOLISHED MATERIALS**

24 A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419
25 "Construction Waste Management and Disposal."

26 1. Do not allow demolished materials to accumulate on-site.

27 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

28 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to
29 grade level in a controlled descent.

30 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

31 B. Burning: Do not burn demolished materials.

32 **3.8 CLEANING**

33 A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations.
34 Return adjacent areas to condition existing before selective demolition operations began.
35
36

37 END OF SECTION 024119

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**SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES**

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27
28
29 **PART 1 – GENERAL**

30
31 **1.1. RELATED DOCUMENTS**

- 32 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
33 Specification Sections, apply to this Section.

34
35 **1.2. SUMMARY**

- 36 A. Section Includes:
37 1. Form-facing material for cast-in-place concrete.

38
39 **1.3. DEFINITIONS**

- 40 A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and
41 gaining sufficient strength to be self-supporting.
42 B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the
43 concrete, as well as supporting members, hardware, and necessary bracing.

44
45 **1.4. PREINSTALLATION MEETINGS**

- 46 A. Preinstallation Conference: Conduct conference at **Project site**.
47 1. Review the following:
48 a. Construction, movement, contraction, and isolation joints
49 b. Forms and form-removal limitations.
50 c. Anchor rod and anchorage device installation tolerances.

51
52 **1.5. ACTION SUBMITTALS**

- 53 A. Product Data: For each of the following:
54 1. Exposed surface form-facing material.
55 2. Concealed surface form-facing material.
56 3. Form ties.
57 4. Waterstops.
58 5. Form-release agent.

- 1 B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their
- 2 preparation, detailing fabrication, assembly, and support of forms.
- 3 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
- 4 2. Indicate dimension and locations of construction and movement joints required to construct the structure
- 5 in accordance with ACI 301.
- 6 a. Location of construction joints is subject to approval of the Architect.
- 7 3. Indicate proposed schedule and sequence of stripping of forms.
- 8 C. Samples:
- 9 1. For waterstops.

1.6. INFORMATIONAL SUBMITTALS

- 12 A. Field quality-control reports.
- 13 B. Minutes of preinstallation conference.

1.7. DELIVERY, STORAGE, AND HANDLING

- 17 A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 22 A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork in accordance with ACI 301, to
- 23 support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can
- 24 support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
- 25 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
- 26 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of
- 27 supports.

2.2 FORM-FACING MATERIALS

- 30 A. As-Cast Surface Form-Facing Material:
- 31 1. Provide continuous, true, and smooth concrete surfaces.
- 32 2. Furnish in largest practicable sizes to minimize number of joints.
- 33 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000
- 34 "Cast-In-Place Concrete, and as follows:
- 35 a. Plywood, metal, or other approved panel materials.
- 36 b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as
- 37 follows:
- 38 1) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
- 39 B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
- 40 1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 WATERSTOPS

- 43 A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, **with factory-installed metal eyelets**, for
- 44 embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections,
- 45 and directional changes.
- 46 1. Profile: **Ribbed with center bulb**.
- 47 2. Dimensions: **4 inches by 3/16 inch thick**; nontapered.

2.4 RELATED MATERIALS

- 50 B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- 51 C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely
- 52 affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
- 53 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- 54 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- 55 D. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to
- 56 resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
- 57 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
- 58 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

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PART 3 – EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. **Chamfer** exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls **as indicated on Drawings**.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

- 1 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5
2 of AISC 303.
3 3. Clean embedded items immediately prior to concrete placement.
4

5 **3.3 INSTALLATION OF WATERSTOPS**

- 6 A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
7 1. Install in longest lengths practicable.
8 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
9 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete
10 aggregate size specified in Section 033000 "Cast-In-Place Concrete."
11 4. Secure waterstops in correct position at 12 inches on center.
12 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
13 a. Miter corners, intersections, and directional changes in waterstops.
14 b. Align center bulbs.
15 6. Clean waterstops immediately prior to placement of concrete.
16 7. Support and protect exposed waterstops during progress of the Work.
17

18 **3.4 REMOVING AND REUSING FORMS**

- 19 A. Formwork for sides of walls and similar parts of the Work that does not support weight of concrete may be
20 removed after cumulatively curing at not less than 50 deg F for **24** hours after placing concrete. Concrete has to be
21 hard enough to not be damaged by form-removal operations, and curing and protection operations need to be
22 maintained.
23 B. Clean and repair surfaces of forms to be reused in the Work.
24 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed
25 surfaces.
26 2. Apply new form-release agent.
27 C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
28 1. Align and secure joints to avoid offsets.
29 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.
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END OF SECTION

**SECTION 03 20 00
CONCRETE REINFORCING**

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Steel reinforcement bars.
 2. Welded-wire reinforcement.
- B. Related Requirements:
1. Section 034100 "Precast Structural Concrete" for reinforcing used in precast structural concrete.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
1. Review the following:
 - a. Construction contraction and isolation joints.
 - b. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Each type of steel reinforcement.
 2. Epoxy repair coating.
 3. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
1. Include placing drawings that detail fabrication, bending, and placement.
 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
 3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- C. Material Test Reports: For the following, from a qualified testing agency:

- 1 1. Steel Reinforcement:
- 2 a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent
- 3 of the steel in accordance with ASTM A706/A706M.
- 4 D. Field quality-control reports.
- 5 E. Minutes of preinstallation conference.
- 6

7 **1.5 QUALITY ASSURANCE**

- 8 A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.
- 9

10 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 11 A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- 12 1. Store reinforcement to avoid contact with earth.
- 13 2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being
- 14 stored under an opaque covering.
- 15

16 **PART 2 - PRODUCTS**

17 **2.1 STEEL REINFORCEMENT**

- 19 A. Reinforcing Bars: ASTM A615/A615M, **Grade 60**, deformed.
- 20 B. Epoxy-Coated Reinforcing Bars: **At Wash Bay Areas**
- 21 1. Steel Bars: **ASTM A615/A615M, Grade 60**, deformed bars.
- 22 C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat
- 23 sheets.
- 24 D. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, **plain** steel.
- 25

26 **2.2 REINFORCEMENT ACCESSORIES**

- 27 A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and
- 28 welded-wire reinforcement in place.
- 29 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of
- 30 Standard Practice," of greater compressive strength than concrete and as follows:
- 31 a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI
- 32 Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar
- 33 supports.
- 34 b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated
- 35 wire bar supports.
- 36 B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
- 37 1. Finish: **Plain**.
- 38 C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and
- 39 complying with ASTM A775/A775M.
- 40

41 **2.3 FABRICATING REINFORCEMENT**

- 42 A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
- 43

44 **PART 3 - EXECUTION**

45 **3.1 PREPARATION**

- 47 A. Protection of In-Place Conditions:
- 48 1. Do not cut or puncture vapor retarder.
- 49 2. Repair damage and reseal vapor retarder before placing concrete.
- 50 B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to
- 51 concrete.
- 52

53 **3.2 INSTALLATION OF STEEL REINFORCEMENT**

- 54 A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- 55 B. Accurately position, support, and secure reinforcement against displacement.
- 56 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
- 57 2. Do not tack weld crossing reinforcing bars.

- 1 C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3
2 times size of large aggregate, whichever is greater.
- 3 D. Provide concrete coverage in accordance with ACI 318.
- 4 E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- 5 F. Splices: Lap splices as indicated on Drawings.
- 6 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices,
7 or 24 inches, whichever is greater.
- 8 2. Stagger splices in accordance with ACI 318.
- 9 G. Install welded-wire reinforcement in longest practicable lengths.
- 10 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
11 a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
- 12 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for
13 deformed wire.
- 14 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
- 15 4. Lace overlaps with wire.
- 16 H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with
17 ASTM D3963/D3963M.

18 19 **3.3 JOINTS**

- 20 A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as
21 approved by Architect.
- 22 1. Place joints perpendicular to main reinforcement.
- 23 2. Continue reinforcement across construction joints unless otherwise indicated.
- 24 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- 25

26 **3.4 INSTALLATION TOLERANCES**

- 27 A. Comply with ACI 117.
- 28

29 **3.5 FIELD QUALITY CONTROL**

- 30 A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit
31 reports.
- 32
- 33

END OF SECTION

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**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

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PART 1 - GENERAL

1.1 SUMMARY

- A. In general, the work includes the following:
1. Footings
 2. Stoops (at doors)
 3. Aprons (at overhead doors, including concrete infill between stoops and aprons)
 4. Cast-in-place concrete work
 5. Interior slabs on grade
 6. Vapor retarder (barrier)
 7. Recessed slab, below-slab drain containment and other concrete work below the floor slabs.
 8. Floor trenches or utility trenches

- 1 9. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
2 B. Related Requirements:
3 1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating
4 concrete forms, and waterstops.
5 2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
6 3. Section 079200 "Joint Sealant"
7 4. Section 321313 "Concrete Paving" for concrete pavement and walks.
8

9 1.2 DEFINITIONS

- 10 A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended
11 hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with
12 requirements.
13 B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
14

15 1.3 PREINSTALLATION MEETINGS

- 16 A. Preinstallation Conference: Conduct conference at **Project site**.
17 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including
18 the following:
19 a. Contractor's superintendent.
20 b. Independent testing agency responsible for concrete design mixtures.
21 c. Ready-mix concrete manufacturer.
22 d. Concrete Subcontractor.
23 2. Review the following:
24 a. Construction joints, control joints, isolation joints, and joint-filler strips.
25 b. Semirigid joint fillers.
26 c. Vapor-retarder installation.
27 d. Anchor rod and anchorage device installation tolerances.
28 e. Cold and hot weather concreting procedures.
29 f. Concrete finishes and finishing.
30 g. Curing procedures.
31 h. Forms and form-removal limitations.
32 i. Methods for achieving specified floor and slab flatness and levelness.
33 j. Floor and slab flatness and levelness measurements.
34 k. Concrete repair procedures.
35 l. Concrete protection.
36 m. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
37 n. Protection of field cured field test cylinders.
38

39 1.4 ACTION SUBMITTALS

- 40 A. Product Data: For each of the following.
41 1. Portland cement.
42 2. Fly ash.
43 3. Slag cement.
44 4. Aggregates.
45 5. Admixtures:
46 a. Include limitations of use, including restrictions on cementitious materials, supplementary
47 cementitious materials, air entrainment, aggregates, temperature at time of concrete placement,
48 relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
49 6. Vapor retarders.
50 7. Floor and slab treatments.
51 8. Liquid floor treatments.
52 9. Curing materials.
53 a. Include documentation from color pigment manufacturer, indicating that proposed methods of
54 curing are recommended by color pigment manufacturer.
55 10. Joint fillers.
56 11. Repair materials.
57 B. Design Mixtures: For each concrete mixture, include the following:
58 1. Mixture identification.

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2. Minimum 28-day compressive strength.
 3. Durability exposure class.
 4. Maximum w/cm.
 5. Slump limit.
 6. Air content.
 7. Nominal maximum aggregate size.
 8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 9. Intended placement method.
 10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- D. Samples: For **vapor retarder**.
- E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Final finish for floors.
 6. Curing process.
 7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

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- A. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Curing compounds.
 4. Floor and slab treatments.
 5. Bonding agents.
 6. Adhesives.
 7. Vapor retarders.
 8. Semirigid joint filler.
 9. Joint-filler strips.
 10. Repair materials.
- B. Material Test Reports: For the following, from a qualified testing agency:
1. Portland cement.
 2. Fly ash.
 3. Aggregates.
 4. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- C. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- D. Research Reports:
1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- E. Preconstruction Test Reports: For each mix design.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

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- A. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

- 1 B. Field Quality-Control Testing Agency Qualifications: An independent agency, **acceptable to authorities having**
2 **jurisdiction**, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
3 1. Personnel conducting field tests to be qualified as an ACI Concrete Field-Testing Technician, Grade 1, in
4 accordance with ACI CPP 610.1 or an equivalent certification program.
5

6 **1.7 PRECONSTRUCTION TESTING**

- 7 A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each
8 concrete mixture.
9 1. Include the following information in each test report:
10 a. Admixture dosage rates.
11 b. Slump.
12 c. Air content.
13 d. Seven-day compressive strength.
14 e. 28-day compressive strength.
15 f. Permeability.
16

17 **1.8 DELIVERY, STORAGE, AND HANDLING**

- 18 A. Comply with ASTM C94/C94M and ACI 301.
19

20 **1.9 FIELD CONDITIONS**

- 21 A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
22 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing
23 actions, or low temperatures.
24 2. When average high and low temperature is expected to fall below 40 deg F for three successive days,
25 maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
26 3. Do not use frozen materials or materials containing ice or snow.
27 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
28 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators
29 unless otherwise specified and approved in mixture designs.
30 B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
31 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
32 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly
33 moist without standing water, soft spots, or dry areas.
34

35 **1.10 WARRANTY**

- 36 A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier
37 material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with
38 requirements or that fail to resist penetration by termites within specified warranty period.
39 1. Warranty Period: 10 years from date of Substantial Completion.
40

41 **PART 2 - PRODUCTS**

42 **2.1 CONCRETE, GENERAL**

- 44 A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.
45

46 **2.2 CONCRETE MATERIALS**

- 47 A. Source Limitations:
48 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
49 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
50 3. Obtain aggregate from single source.
51 4. Obtain each type of admixture from a single source from single manufacturer.
52 B. Cementitious Materials:
53 1. Portland Cement: ASTM C150/C150M, **Type I/II, gray**.
54 2. Fly Ash: ASTM C618, Class C or F.
55 C. Normal-Weight Aggregates: ASTM C33/C33M, **Class 3S** coarse aggregate or better, graded. Provide aggregates from
56 a single source.
57 1. Maximum Coarse-Aggregate Size: **1-1/2 inches** nominal.
58 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- 1 D. Air-Entraining Admixture: ASTM C260/C260M.
2 E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute
3 water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or
4 admixtures containing calcium chloride **in steel-reinforced concrete**.
5
6 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
7 2. Retarding Admixture: ASTM C494/C494M, Type B.
8 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
9 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
10 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
11 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
12 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed
13 cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions
14 with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
15 8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating,
16 anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and
17 minimizing chloride reactions with steel reinforcement in concrete.
- 18 F. Superplasticizer shall be used in all interior flatwork and any pumped concrete unless otherwise approved in writing
19 by the Architect. All concrete with W/C of 0.48 or less, and where pumping equipment is used, requires this
20 admixture. In general, concrete shall be delivered to the site with a slump of 3" to 3 1/2". Admixture shall be site
21 added in lieu of any additional water.
22 G. Water and Water Used to Make Ice: ASTM C94/C94M, potable **or complying with ASTM C1602/C1602M, including**
23 **all limits listed in Table 2 and the requirements of paragraph 5.4**
24
25

26 2.3 VAPOR RETARDERS

- 27 A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's
28 recommended adhesive or pressure-sensitive tape.
29
30

31 2.4 LIQUID FLOOR TREATMENTS (SC-1)

- 32 A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate
33 materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
34 1. Provide Prosoco SLX100 Water and Oil Repellant or equal.
35

36 2.5 CURING MATERIALS (SC-2)

- 37 A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
38 B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq.
39 yd. when dry.
40 C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
41 1. Color:
42 a. Ambient Temperature Below 50 deg F: Black.
43 b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
44 c. Ambient Temperature Above 85 deg F: White.
45 D. Water: Potable or complying with ASTM C1602/C1602M.
46 E. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
47

48 2.6 RELATED MATERIALS

- 49 A. Expansion- and Isolation-Joint-Filler Strips: **ASTM D1751, asphalt-saturated cellulosic fiber**.
50 B. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp
51 surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
52 1. **Types I and II, nonload bearing**, for bonding hardened or freshly mixed concrete to hardened concrete.
53

54 2.7 REPAIR MATERIALS

- 55 A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses
56 from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

- 1 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined
- 2 in ASTM C219.
- 3 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
- 4 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment
- 5 manufacturer.
- 6 4. Compressive Strength: Not less than **5000 psi** at 28 days when tested in accordance with
- 7 ASTM C109/C109M.
- 8 B. Repair Overlay: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses
- 9 from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
- 10 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined
- 11 in ASTM C219.
- 12 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
- 13 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping
- 14 manufacturer.
- 15 4. Compressive Strength: Not less than **5000 psi** at 28 days when tested in accordance with
- 16 ASTM C109/C109M.
- 17

18 2.8 CONCRETE MIXTURES, GENERAL

- 19 A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial
- 20 mixture or field test data, or both, in accordance with ACI 301.
- 21 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory
- 22 trial mixtures.
- 23
- 24 B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in
- 25 concrete as follows:
- 26 1. Fly Ash or Other Pozzolans: 20 percent by mass.
- 27 C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
- 28 1. Use **water-reducing** admixture in concrete, as required, for placement and workability.
- 29 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other
- 30 adverse placement conditions.
- 31 3. Use water-reducing admixture in **pumped concrete, concrete for heavy-use industrial slabs.**
- 32

33 2.9 CONCRETE MIXTURES

- 34 A. Class A: Normal-weight concrete used for footings.
- 35 1. Exposure Class: ACI 318 **F1-S0-W0-C0.**
- 36 2. Minimum Compressive Strength **3500 psi** at 28 days.
- 37 3. Maximum w/cm: 0.55.
- 38 4. Slump Limit: **4 inches, plus or minus 1 inch.**
- 39 5. Air Content:
- 40 a. Exposure Class F1: **4.5 percent, plus or minus 1.5 percent at point of delivery for concrete**
- 41 **containing 1-1/2-inch nominal maximum aggregate size.**
- 42 B. Class B: Normal-weight concrete used for foundation walls.
- 43 1. Exposure Class: ACI 318 **F1-S0-W0-C0.**
- 44 2. Minimum Compressive Strength: **4000 psi** at 28 days.
- 45 3. Maximum w/cm: **0.45**
- 46 4. Slump Limit: **4 inches, plus or minus 1 inch.**
- 47 5. Air Content:
- 48 a. Exposure Class F1: **5.0 percent, plus or minus 1.5 percent at point of delivery for concrete**
- 49 **containing 3/4-inch nominal maximum aggregate size**
- 50 6. Limit water-soluble, chloride-ion content in hardened concrete to **1.00** percent by weight of cement.
- 51 C. Class C: Normal-weight concrete used for interior slabs-on-ground.
- 52 1. Exposure Class: ACI 318 **F0-S0-W0-C0.**
- 53 2. Minimum Compressive Strength: **4500 psi** at 28 days.
- 54 3. Maximum w/cm: **0.40.**
- 55 4. Slump Limit: **5 inches, plus or minus 1 inch.**
- 56 5. Air Content:
- 57 a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete
- 58 used in trowel-finished floors.

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2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 - 2. Face laps away from exposed direction of concrete pour.
 - 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 - 7. All overlapped conditions and terminations shall be sealed off and taped in a watertight manner.
 - 8. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

- 1 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened
2 concrete surfaces.
3 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially
4 hardened concrete surfaces.
5 C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated.
6 Construct control joints for a depth equal to at least **one-fourth** of concrete thickness as follows:
7 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-
8 rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or
9 otherwise damage surface and before concrete develops random cracks.
10 D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical
11 surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
12 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless
13 otherwise indicated on Drawings.
14 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete
15 surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.

16 17 **3.6 CONCRETE PLACEMENT**

- 18 A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is
19 complete and that required inspections are completed.
20 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and
21 repair defective areas.
22 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to
23 damaged areas as Work progresses.
24 B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
25 C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in
26 writing, but not to exceed the amount indicated on the concrete delivery ticket.
27 D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but
28 not to exceed the amount indicated on the concrete delivery ticket.
29 E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed
30 on concrete that has hardened enough to cause seams or planes of weakness.
31 1. If a section cannot be placed continuously, provide construction joints as indicated.
32 2. Deposit concrete to avoid segregation.
33 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to
34 avoid inclined construction joints.
35 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
36 a. Do not use vibrators to transport concrete inside forms.
37 b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed
38 layer and at least 6 inches into preceding layer.
39 c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
40 d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and
41 complete embedment of reinforcement and other embedded items without causing mixture
42 constituents to segregate.
43 F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints,
44 until placement of a panel or section is complete.
45 1. Do not place concrete floors and slabs in a checkerboard sequence.
46 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement
47 and other embedded items and into corners.
48 3. Maintain reinforcement in position on chairs during concrete placement.
49 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
50 5. Level concrete, cut high areas, and fill low areas.
51 6. Slope surfaces uniformly to drains where required.
52 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before
53 excess bleedwater appears on the surface.
54 8. Do not further disturb slab surfaces before starting finishing operations.
55 G. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface
56 produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hang-troweling
57 operation, free of trowel marks, uniform in texture and appearance, and with a level surface plane so that

1 depressions between high spots do not exceed tolerances listed below. Grind smooth defects which would telegraph
2 through applied floor covering system only in acceptable to Architect.

- 3 1. Finish tolerances:
4 a. All locations except as noted:
5 1) specified overall $F_F = 50$
6 2) specified overall $F_L = 35$
7 3) specified local $F_F = 30$
8 4) specified local $F_L = 20$
9

10 3.7 FINISHING FORMED SURFACES

- 11 A. As-Cast Surface Finishes:
12 1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
13 a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
14 b. Remove projections larger than 1 inch.
15 c. Tie holes do not require patching.
16 d. Surface Tolerance: ACI 117 Class D.
17 e. Apply to concrete surfaces **not exposed to public view**.
18 2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an
19 orderly and symmetrical manner with a minimum of seams.
20 a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
21 b. Remove projections larger than 1/4 inch.
22 c. Patch tie holes.
23 d. Surface Tolerance: ACI 117 Class B.
24 e. Locations: Apply to concrete surfaces **exposed to public view**.
25 3. ACI 301 Surface Finish SF-3.0:
26 a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
27 b. Remove projections larger than 1/8 inch.
28 c. Patch tie holes.
29 d. Surface Tolerance: ACI 117 Class A.
30 e. Locations: Apply to concrete surfaces **exposed to public view**.
31

32 3.8 FINISHING FLOORS AND SLABS

- 33 A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete
34 surfaces. Do not wet concrete surfaces.
35 B. Float Finish:
36 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit
37 operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand
38 floating if area is small or inaccessible to power-driven floats.
39 2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and
40 complies with ACI 117 tolerances for conventional concrete.
41 3. Apply float finish to surfaces **to receive trowel finish**.
42 C. Trowel Finish:
43 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
44 2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and
45 appearance.
46 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
47 4. Do not add water to concrete surface.
48 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
49 6. Apply a trowel finish to surfaces **exposed to view**.
50 7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor
51 surface:
52 a. Slabs on Ground:
53 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled,
54 freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on
55 the surface does not exceed **1/8 inch**.
56

57 3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- 58 A. Filling In:

- 1 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise
- 2 indicated.
- 3 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
- 4 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- 5 B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-
- 6 troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- 7 C. Equipment Bases and Foundations:
- 8 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
- 9 2. Construct concrete bases **4 inches** high unless otherwise indicated on Drawings, and extend base not less
- 10 than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise
- 11 indicated on Drawings, or unless required for seismic anchor support.
- 12 3. Minimum Compressive Strength: **3000 psi** at 28 days.
- 13 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods
- 14 on 18-inch centers around the full perimeter of concrete base.
- 15 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor
- 16 into structural concrete substrate.
- 17 6. Prior to pouring concrete, place and secure anchorage devices.
- 18 a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be
- 19 embedded.
- 20 b. Cast anchor-bolt insert into bases.
- 21 c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 22 D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
- 23 1. Cast-in inserts and accessories, as shown on Drawings.
- 24 2. Screed, tamp, and trowel finish concrete surfaces.
- 25

3.10 CONCRETE CURING

- 27 A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- 28 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
- 29 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
- 30 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and
- 31 during finishing operations.
- 32 B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
- 33 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
- 34 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
- 35 3. If forms remain during curing period, moist cure after loosening forms.
- 36 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
- 37 a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
- 38 b. Continuous Sprinkling: Maintain concrete surface continuously wet.
- 39 c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to
- 40 absorptive material to maintain concrete surface continuously wet.
- 41 d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material,
- 42 taping, or lapping seams.
- 43 e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or
- 44 roller in accordance with manufacturer's written instructions.
- 45 1) Recoat areas subject to heavy rainfall within three hours after initial application.
- 46 2) Maintain continuity of coating and repair damage during curing period.
- 47 C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
- 48 1. Begin curing immediately after finishing concrete.
- 49 2. Interior Concrete Floors:
- 50 a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the
- 51 following:
- 52 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without
- 53 marring concrete surface, install prewetted absorptive cover over entire area of floor.
- 54 a) Lap edges and ends of absorptive cover not less than 12 inches.
- 55 b) Maintain absorptive cover water saturated, and in place, for duration of curing
- 56 period, but not less than seven days.

- 1 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for
2 curing concrete, placed in widest practicable width, with sides and ends lapped at least 12
3 inches, and sealed by waterproof tape or adhesive.
- 4 a) Immediately repair any holes or tears during curing period, using cover material and
5 waterproof tape.
- 6 b) Cure for not less than seven days.
- 7 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for
8 not less than seven days, utilizing one, or a combination of, the following:
- 9 a) Water.
- 10 b) Continuous water-fog spray.
- 11 b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
- 12 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without
13 marring concrete surface, install prewetted absorptive cover over entire area of floor.
- 14 a) Lap edges and ends of absorptive cover not less than 12 inches.
- 15 b) Maintain absorptive cover water saturated, and in place, for duration of curing
16 period, but not less than seven days.
- 17 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for
18 curing concrete, placed in widest practicable width, with sides and ends lapped at least 12
19 inches, and sealed by waterproof tape or adhesive.
- 20 a) Immediately repair any holes or tears during curing period, using cover material and
21 waterproof tape.
- 22 b) Cure for not less than seven days.
- 23 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for
24 not less than seven days, utilizing one, or a combination of, the following:
- 25 a) Water.
- 26 b) Continuous water-fog spray.
- 27 c. Floors to Receive Polished Finish: Contractor has option of the following:
- 28 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without
29 marring concrete surface, install prewetted absorptive cover over entire area of floor.
- 30 a) Lap edges and ends of absorptive cover not less than 12 inches.
- 31 b) Maintain absorptive cover water saturated, and in place, for duration of curing
32 period, but not less than seven days.
- 33 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for
34 not less than seven days, utilizing one, or a combination of, the following:
- 35 a) Water.
- 36 b) Continuous water-fog spray.
- 37 d. Floors to Receive Chemical Stain:
- 38 1) As soon as concrete has sufficient set to permit application without marring concrete
39 surface, install curing paper over entire area of floor.
- 40 2) Install curing paper square to building lines, without wrinkles, and in a single length without
41 end joints.
- 42 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
- 43 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- 44 e. Floors to Receive Urethane Flooring:
- 45 1) As soon as concrete has sufficient set to permit application without marring concrete
46 surface, install prewetted absorptive cover over entire area of floor.
- 47 2) Rewet absorptive cover and cover immediately with polyethylene moisture-retaining cover
48 with edges lapped 6 inches and sealed in place.
- 49 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under
50 polyethylene moisture-retaining cover.
- 51 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of
52 curing period, but not less than 28 days.
- 53 f. Floors to Receive Curing Compound:
- 54 1) Apply uniformly in continuous operation by power spray or roller in accordance with
55 manufacturer's written instructions.
- 56 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 57 3) Maintain continuity of coating, and repair damage during curing period.

- 1 4) Removal: After curing period has elapsed, remove curing compound without damaging
2 concrete surfaces by method recommended by curing compound manufacturer **unless**
3 **manufacturer certifies curing compound does not interfere with bonding of floor covering**
4 **used on Project.**

5 g. Floors to Receive Curing and Sealing Compound:

- 6 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or
7 roller in accordance with manufacturer's written instructions.
8 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
9 3) Repeat the process 24 hours later and apply a second coat. Maintain continuity of coating,
10 and repair damage during curing period.
11

12 **3.11 TOLERANCES**

- 13 A. Conform to ACI 117.
14

15 **3.12 APPLICATION OF LIQUID FLOOR TREATMENTS**

- 16 A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with
17 manufacturer's written instructions.
18 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
19 2. Do not apply to concrete that is less than **14** days' old.
20 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming
21 or scrubbing.
22 4. Rinse with water; remove excess material until surface is dry.
23 5. Apply a second coat in a similar manner if the surface is rough or porous.
24

25 **3.13 JOINT FILLING**

- 26 A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
27 1. Defer joint filling until concrete has aged at least **six** month(s).
28 2. Do not fill joints until construction traffic has permanently ceased.
29 B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and
30 dry.
31 C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
32 D. Overfill joint, and trim joint filler flush with top of joint after hardening.
33

34 **3.14 CONCRETE SURFACE REPAIRS**

- 35 A. Defective Concrete:
36 1. Repair and patch defective areas when approved by Architect.
37 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
38 B. Patching Mortar: Mix dry pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate
39 passing a No. 16 sieve, using only enough water for handling and placing.
40 C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles,
41 honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that
42 cannot be removed by cleaning.
43 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any
44 dimension to solid concrete.
45 a. Limit cut depth to 3/4 inch.
46 b. Make edges of cuts perpendicular to concrete surface.
47 c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
48 d. Fill and compact with patching mortar before bonding agent has dried.
49 e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
50 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland
51 cement, so that, when dry, patching mortar matches surrounding color.
52 a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding
53 with patching.
54 b. Compact mortar in place and strike off slightly higher than surrounding surface.
55 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural
56 performance as determined by Architect.
57 D. Repairing Unformed Surfaces:

- 1 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each
- 2 surface.
- 3 a. Correct low and high areas.
- 4 b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
- 5 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets,
- 6 crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through
- 7 unreinforced sections regardless of width, and other objectionable conditions.
- 8 3. After concrete has cured at least 14 days, correct high areas by grinding.
- 9 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting
- 10 out low areas and replacing them with patching mortar.
- 11 a. Finish repaired areas to blend into adjacent concrete.
- 12 5. Correct other low areas scheduled to remain exposed with repair topping.
- 13 a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor
- 14 elevations.
- 15 b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written
- 16 instructions to produce a smooth, uniform, plane, and level surface.
- 17 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and
- 18 replacing with fresh concrete.
- 19 a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-
- 20 inch clearance all around.
- 21 b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
- 22 c. Mix patching concrete of same materials and mixture as original concrete, except without coarse
- 23 aggregate.
- 24 d. Place, compact, and finish to blend with adjacent finished concrete.
- 25 e. Cure in same manner as adjacent concrete.
- 26 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
- 27 a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose
- 28 particles.
- 29 b. Dampen cleaned concrete surfaces and apply bonding agent.
- 30 c. Place patching mortar before bonding agent has dried.
- 31 d. Compact patching mortar and finish to match adjacent concrete.
- 32 e. Keep patched area continuously moist for at least 72 hours.
- 33 E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- 34 F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 35

3.15 FIELD QUALITY CONTROL

- 36 A. Testing Agency: **Engage** a qualified testing and inspecting agency to perform tests and inspections and to submit
- 37 reports.
- 38 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying
- 39 that field-cured composite samples are cured in accordance with ASTM C31/C31M.
- 40 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of
- 41 Work to comply with Contract Documents.
- 42 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and
- 43 concrete manufacturer within 48 hours of inspections and tests.
- 44 a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301,
- 45 including the following as applicable to each test and inspection:
- 46 1) Project name.
- 47 2) Name of testing agency.
- 48 3) Names and certification numbers of field and laboratory technicians performing inspections
- 49 and testing.
- 50 4) Name of concrete manufacturer.
- 51 5) Date and time of inspection, sampling, and field testing.
- 52 6) Date and time of concrete placement.
- 53 7) Location in Work of concrete represented by samples.
- 54 8) Date and time sample was obtained.
- 55 9) Truck and batch ticket numbers.
- 56 10) Design compressive strength at 28 days.
- 57 11) Concrete mixture designation, proportions, and materials.
- 58

- 12) Field test results.
- 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
- 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of **two** 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of **two** laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
 11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within **24** hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

- A. Protect concrete surfaces as follows:

- 1 1. Protect from petroleum stains.
- 2 2. Diaper hydraulic equipment used over concrete surfaces.
- 3 3. Prohibit vehicles from interior concrete slabs.
- 4 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
- 5 5. Prohibit placement of steel items on concrete surfaces.
- 6 6. Prohibit use of acids or acidic detergents over concrete surfaces.
- 7 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use
8 protective methods and materials, including temporary covering, recommended in writing by liquid floor
9 treatments installer.
- 10 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab
11 Protective Covering.

END OF SECTION

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SECTION 03 41 00
PRECAST STRUCTURAL CONCRETE

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PART 1 - GENERAL

1.1 SUMMARY

- 51 A. Section Includes:
52 1. Precast structural concrete.
53 B. Related Requirements:
54 1. Section 051200 "Structural Steel Framing" for furnishing and installing connections attached to structural-
55 steel framing.
56
57
58

1 **1.2 PREINSTALLATION MEETINGS**

- 2 A. Preinstallation Conference: Conduct conference at **Project site**.

3
4 **1.3 ACTION SUBMITTALS**

- 5 A. Product Data: For each type of product.
- 6 B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-
7 absorption tests.
- 8 C. Shop Drawings:
- 9 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support
10 conditions, and types of reinforcement, including special reinforcement.
 - 11 2. Detail fabrication and installation of precast structural concrete units, including connections at member
12 ends and to adjoining construction.
 - 13 3. Indicate type, size, and length of welded connections by AWS standard symbols.
 - 14 4. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 15 5. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure
16 or other construction.
 - 17 6. Include and locate openings larger than 10 inches. Where additional structural support is required, include
18 header design.
 - 19 7. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 - 20 8. Indicate relationship of precast structural concrete units to adjacent materials.
 - 21 9. Indicate locations, dimensions, and details of thin-brick units, including corner units and special shapes, and
22 joint treatment.
 - 23 10. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
 - 24 11. Indicate estimated camber for precast floor slabs with concrete toppings.
 - 25 12. Indicate shim sizes and grouting sequence.
 - 26 13. If design modifications are proposed to meet performance requirements and field conditions, submit design
27 calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units
28 when modifying details or materials and maintain the general design concept.
- 29 D. Delegated Design Submittal: For precast structural concrete indicated to comply with performance requirements
30 and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for
31 their preparation.
- 32 1. Show precast structural concrete unit types, connections, types of reinforcement, including special
33 reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of
34 loads imposed on the building structural frame from precast structural concrete.

35
36 **1.4 INFORMATIONAL SUBMITTALS**

- 37 A. Welding certificates.
- 38 B. Material Test Reports: For aggregates, by a qualified testing agency.
- 39 C. Preconstruction test reports.
- 40 D. Source quality-control reports.
- 41 E. Field quality-control reports.

42
43 **1.5 QUALITY ASSURANCE**

- 44 A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to
45 comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive
46 engineering analysis by a qualified professional engineer.
- 47 1. Designated as a PCI-certified plant as follows:
 - 48 a. Group C, **Category C2 - Prestressed Hollowcore and Repetitively Produced Products**.
- 49 B. Required Certified Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of
50 Compliance, to erect **Category S1 - Simple** Structural Systems.
- 51 C. Installer Qualifications: An experienced precast concrete erector who has retained a "PCI-Certified Field Auditor" to
52 conduct a field audit of a project installed by erector in **Category S1 - Simple** Structural Systems and who can
53 produce an Erectors' Post Audit Declaration, according to PCI MNL 127, "PCI Erector's Manual - Standards and
54 Guidelines for the Erection of Precast Concrete Products."
- 55 D. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
- 56 E. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control
57 recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and
58 Production of Structural Precast Concrete Products."

- 1 F. Welding Qualifications: Qualify procedures and personnel according to the following:
2 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
3 2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."
4
5

6 **1.6 COORDINATION**

- 7 A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction
8 before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required,
9 for installation.
10

11 **1.7 DELIVERY, STORAGE, AND HANDLING**

- 12 A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
13 B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent
14 cracking, distortion, warping or other physical damage.
15 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
16 2. Place adequate dunnage of even thickness between each unit.
17 3. Place stored units so identification marks are clearly visible, and units can be inspected.
18 C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
19 D. Lift and support units only at designated points indicated on Shop Drawings.
20

21 **PART 2 - PRODUCTS**

22 **2.1 PERFORMANCE REQUIREMENTS**

- 23 A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements,"
24 to design precast structural concrete units.
25 B. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook -
26 Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
27 C. Structural Performance:
28 1. Precast structural concrete units and connections to withstand design loads indicated within limits and
29 under conditions indicated.
30 2. Provide precast structural concrete units and connections capable of withstanding the following design
31 loads within limits and under conditions indicated:
32 a. Dead Loads: Self-weight (61 psf assumed).
33 b. Concrete Topping Load: 2hr rating over battery room.
34 c. Live Loads: 125 psf.
35 d. Design precast structural concrete framing system and connections to maintain clearances at
36 openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection,
37 shrinkage and creep of primary building structure, and other building movements. Maintain precast
38 structural concrete deflections within limits of ACI 318.
39
40

41 **2.2 MOLD MATERIALS**

- 42 A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast
43 concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing
44 required finishes.
45 1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or
46 adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of
47 precast concrete.
48

49 **2.3 REINFORCING MATERIALS**

- 50 A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
51 B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.
52 C. Steel Bar Mats: ASTM A184/A184M, fabricated from **ASTM A615/A615M, Grade 60**, deformed bars, assembled
53 with clips.
54 D. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, fabricated from **galvanized-steel** wire into flat sheets.
55 E. Deformed-Steel Welded Wire Reinforcement: ASTM A497/A497M or ASTM A1064/A1064M, flat sheet.
56 F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing,
57 supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.
58

1 **2.4 PRESTRESSING TENDONS**

- 2 A. Pretensioning Strand: **ASTM A416/A416M, Grade 250 or Grade 270, uncoated, seven-wire**, low-relaxation strand.
3 B. Unbonded Post-Tensioning Strand: ASTM A416/A416M, Grade 270, uncoated, seven-wire, low-relaxation strand.
4 1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath
5 with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler
6 assemblies.
7 C. Post-Tensioning Bars: ASTM A722/A722M, uncoated high-strength steel bar.
8
9

10 **2.5 CONCRETE MATERIALS**

- 11 A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.
12 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill
13 source.
14 B. Supplementary Cementitious Materials:
15 1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
16 2. Metakaolin: ASTM C618, Class N.
17 3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
18 4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
19 C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C33/C33M, with coarse aggregates
20 complying with **Class 5S**. Stockpile fine and coarse aggregates for each type of exposed finish from a single source
21 (pit or quarry) for Project.
22 D. Lightweight Aggregates: Except as modified by PCI MNL 116, ASTM C330/C330M, with absorption less than 11
23 percent.
24 E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and
25 complying with chemical limits of PCI MNL 116.
26 F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
27 G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium
28 chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
29 1. Water-Reducing Admixtures: ASTM C494/C494M, Type A.
30 2. Retarding Admixture: ASTM C494/C494M, Type B.
31 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
32 4. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.
33 5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
34 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
35 7. Plasticizing Admixture: ASTM C1017/C1017M, Type I.
36 8. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
37 9. Corrosion-Inhibiting Admixture: ASTM C1582/C1582M.
38

39 **2.6 STEEL CONNECTION MATERIALS**

- 40 A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.
41 B. Carbon-Steel-Headed Studs: ASTM A108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B,
42 with arc shields and with minimum mechanical properties of PCI MNL 116.
43 C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.
44 D. Malleable-Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.
45 E. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30.
46 F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.
47 G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.
48 H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65.
49 I. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.
50 J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts,
51 ASTM A563; and flat, unhardened steel washers, ASTM F844.
52 K. High-Strength Bolts, Nuts, and Washers:
53 1. ASTM F3125/F3125M, Grade A325 Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-
54 hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
55 a. Finish: **Plain**.
56 2. ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-
57 hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

- 1 L. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in
- 2 concrete, according to requirements in SSPC-SP 3, and shop apply according to SSPC-PA 1.
- 3 M. Welding Electrodes: Comply with AWS standards.
- 4 N. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast
- 5 structural concrete units.
- 6
- 7

8 2.7 BEARING PADS

- 9 A. Provide one of the following bearing pads for precast structural concrete units **as recommended by precast**
- 10 **fabricator for application:**
- 11 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer,
- 12 molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D2240;
- 13 minimum tensile strength 2250 psi, ASTM D412.
- 14 2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in
- 15 elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D2240; capable of supporting a compressive
- 16 stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one
- 17 specimen for every 200 pads used in Project.
- 18 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric
- 19 bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D2240; complying with
- 20 AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
- 21 4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-
- 22 fiber-reinforced elastomeric pads; of type required for in-service stress.
- 23 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.
- 24

25 2.8 ACCESSORIES

- 26 A. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to
- 27 install structural precast concrete units.
- 28

29 2.9 GROUT MATERIALS

- 30 A. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica
- 31 sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with
- 32 ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for
- 33 application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight
- 34 of cement when tested according to ASTM C1218/C1218M.
- 35
- 36

37 2.10 CONCRETE MIXTURES

- 38 A. Prepare design mixtures for each type of precast concrete required.
- 39 1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total
- 40 amount of portland cement, which would otherwise be used, by not less than 40 percent.
- 41 2. Limit use of fly ash to **20** percent replacement of portland cement by weight and ground granulated blast-
- 42 furnace slag to **20** percent of portland cement by weight; metakaolin and silica fume to 10 percent of
- 43 portland cement by weight.
- 44 B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel
- 45 at precast structural concrete fabricator's option.
- 46 C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or
- 47 PCI MNL 116 when tested according to ASTM C1218/C1218M.
- 48 D. Normal-Weight Concrete Mixtures: Proportion **full-depth mixture** by either laboratory trial batch or field test data
- 49 methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the
- 50 following properties:
- 51 1. Compressive Strength (28 Days): 5000 psi.
- 52 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- 53

54 2.11 MOLD FABRICATION

- 55 A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-
- 56 placement operations and temperature changes and for prestressing and detensioning operations. Coat contact
- 57 surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and
- 58 prestressing tendons by release agent.

- 1 B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated,
2 within fabrication tolerances specified.
3 1. Edge and Corner Treatment: Uniformly **chamfered**.

4
5
6 **2.12 FABRICATION**

- 7 A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with
8 sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of
9 loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not
10 affect position of main reinforcement or concrete placement.
11 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and
12 AWS C5.4, "Recommended Practices for Stud Welding."
13 B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and
14 other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
15 C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract
16 Drawings.
17 D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without
18 Architect's approval.
19 E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting
20 reinforcement.
21 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond
22 with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in
23 ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar
24 ends after cutting.
25 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement
26 and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
27 3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover.
28 Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive
29 environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold
30 reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete
31 surfaces.
32 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh
33 spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous
34 laps in either direction.
35 F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-
36 place loads.
37 G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply
38 with PCI MNL 116.
39 1. Delay tensioning or post-tensioning of precast, prestressed structural concrete units until concrete has
40 reached its indicated minimum design release compressive strength as established by test cylinders cured
41 under same conditions as concrete unit.
42 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons,
43 using a sequence and pattern to prevent shock or unbalanced loading.
44 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional
45 changes that may cause cracking or undesirable stresses.
46 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and
47 possible rust spots.
48 5. Protect strand ends and anchorages with a minimum of 1-inch- thick, nonmetallic, nonshrink, grout mortar
49 and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
50 H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing
51 concrete. After concrete batching, no additional water may be added.
52 I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast
53 concrete units.
54 J. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in
55 items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures
56 complying with PCI MNL 116.

- 1 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of
2 Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate
3 bond between face and backup concrete, if used.
- 4 K. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.
- 5 L. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings,
6 complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast
7 structural concrete unit on a surface that does not show in finished structure.
- 8 M. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated
9 heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to
10 ensure that stripping does not have an effect on performance or appearance of final product.
- 11 N. Discard and replace precast structural concrete units that do not comply with requirements, including structural,
12 manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's
13 approval.
- 14
15

16 2.13 FABRICATION TOLERANCES

- 17 A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies
18 with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.
- 19

20 2.14 COMMERCIAL FINISHES

- 21 A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes
22 smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls
23 are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in.. Major or
24 unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- 25

26 2.15 SOURCE QUALITY CONTROL

- 27 A. Testing Agency: **Engage** a qualified testing agency to evaluate precast structural concrete fabricator's quality-
28 control and testing methods.
- 29 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement,
30 and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures
31 as may be requested for additional testing and evaluation.
- 32 B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and
33 ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712/C1712M.
- 34 1. Test and inspect self-consolidating concrete according to PCI TR-6.
- 35 C. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 requirements
36 for concrete strength.
- 37 D. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318
38 requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete
39 to determine compressive strength according to ASTM C42/C42M.
- 40 1. A minimum of three representative cores to be taken from units of suspect strength, from locations
41 directed by Architect.
- 42 2. Test cores in an air-dry condition or, if units are wet under service conditions, test cores after immersion in
43 water in a wet condition.
- 44 3. Strength of concrete for each series of three cores is considered satisfactory if average compressive
45 strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than
46 75 percent of 28-day design compressive strength.
- 47 4. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor,
48 and precast concrete fabricator. Test reports include the following:
- 49 a. Project identification name and number.
- 50 b. Date when tests were performed.
- 51 c. Name of precast concrete fabricator.
- 52 d. Name of concrete testing agency.
- 53 e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design
54 compressive strength; type of break; compressive strength at breaks, corrected for length-diameter
55 ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- 56 E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean
57 and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish
58 to match adjacent precast concrete surfaces.

- 1 F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements,
2 including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may
3 be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match
4 approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that
5 comply with requirements.
6

7 **PART 3 - EXECUTION**

8
9 **3.1 EXAMINATION**

- 10 A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation
11 tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
12 B. Proceed with installation only after unsatisfactory conditions have been corrected.
13 C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design
14 compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast
15 concrete units.
16

17 **3.2 INSTALLATION**

- 18 A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units
19 to supporting members and backup materials.
20 B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary
21 structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until
22 permanent connections are complete.
23 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are
24 being erected. Tack weld steel shims to each other to prevent shims from separating.
25 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
26 3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within
27 recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
28 4. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and
29 tape butt joint at end of slabs.
30 C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on
31 Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting
32 are completed.
33 1. Do not permit connections to disrupt continuity of roof flashing.
34 D. Field cutting of precast units is not permitted without approval of Architect.
35 E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed
36 concrete units.
37 F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding
38 electrodes, appearance, quality of welds, and methods used in correcting welding work.
39 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting
40 operations, and provide noncombustible shields as required.
41 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-
42 mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A780/A780M.
43 3. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
44 G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after
45 final adjustment.
46 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly
47 secure bolt but allow bolt to move within connection slot.
48 2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
49 a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490
50 Bolts."
51 b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A325 or
52 A 490 Bolts."
53 c. Twist-off Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
54 d. Direct-Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
55 3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated
56 with inspection agency.
57 H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways,
58 connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard

- 1 enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are
- 2 completely filled.
- 3 1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
- 4 2. Fill joints completely without seepage to other surfaces.
- 5 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels
- 6 not steeper than 1 to 12.
- 7 4. Place grout end cap or dam in voids at ends of hollow-core slabs.
- 8 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- 9 6. Keep grouted joints damp for not less than 24 hours after initial set.

10

11 **3.3 ERECTION TOLERANCES**

- 12 A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative
- 13 erection tolerances of PCI MNL 135.
- 14 B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by
- 15 fabricator and approved by Architect.

16

16 **3.4 FIELD QUALITY CONTROL**

- 17 A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- 18 B. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength
- 19 bolted connections are subject to inspections.
- 20 C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- 21 D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified
- 22 requirements.
- 23 E. Additional testing and inspecting, at Contractor's expense, to be performed to determine compliance of replaced or
- 24 additional work with specified requirements.
- 25 F. Prepare test and inspection reports.

26

27 **3.5 REPAIRS**

- 28 A. Repair precast structural concrete units if permitted by Architect.
- 29 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not
- 30 been impaired.
- 31 B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent
- 32 exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in
- 33 typical daylight illumination from a distance of 20 feet.
- 34 C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- 35 D. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not
- 36 comply with requirements as determined by Architect.

37

38 **3.6 CLEANING**

- 39 A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent
- 40 materials immediately.
- 41 B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld
- 42 marks, other markings, dirt, and stains.
- 43 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written
- 44 recommendations. Protect other work from staining or damage due to cleaning operations.
- 45 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes
- 46 or damage adjacent materials.

47

END OF SECTION

48

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**SECTION 04 22 00
CONCRETE UNIT MASONRY**

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38			
39	1.1 SUMMARY		
40	A. Section includes:		
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42	2. Mortar and grout.		
43	3. Steel reinforcing bars.		
44	4. Masonry-joint reinforcement.		
45	5. Miscellaneous masonry accessories.		
46	1.2 DEFINITIONS		
47	A. CMU(s): Concrete masonry unit(s).		
48	B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.		
49	1.3 PREINSTALLATION MEETINGS		
50	A. Preinstallation Conference: Conduct conference at Project site.		
51	1.4 ACTION SUBMITTALS		
52	A. Product Data: For each type of product.		
53	B. Sustainable Design Submittals:		
54			
55	1. Regional Materials: Verify CMUs are manufactured within 100 miles of Project site from aggregates and		
56	cement that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of		
57	Project site.		

- 1 2. Regional Materials: Manufacture aggregate for mortar and grout, cement, and lime within 100 miles of
- 2 Project site from materials that have been extracted, harvested, or recovered, as well as manufactured,
- 3 within 100 miles of Project site.
- 4 C. Shop Drawings: For the following:
- 5 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
- 6 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with
- 7 ACI 315.
- 8 1.5 INFORMATIONAL SUBMITTALS
- 9 A. Qualification Data: For testing agency.
- 10 B. Material Certificates: For each type and size of the following:
- 11 1. Masonry units.
- 12 a. Include data on material properties.
- 13 b. For masonry units, include data and calculations establishing average net-area compressive strength
- 14 of units.
- 15 2. Cementitious materials. Include name of manufacturer, brand name, and type.
- 16 3. Mortar admixtures.
- 17 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
- 18 5. Grout mixes. Include description of type and proportions of ingredients.
- 19 6. Reinforcing bars.
- 20 7. Joint reinforcement.
- 21 8. Anchors, ties, and metal accessories.
- 22 C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
- 23 1. Include test reports for mortar mixes required to comply with property specification. Test in accordance
- 24 with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M
- 25 for air content.
- 26 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive
- 27 strength requirement.
- 28 D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used
- 29 to comply with requirements.
- 30 1.6 QUALITY ASSURANCE
- 31 A. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.
- 32 1.7 DELIVERY, STORAGE, AND HANDLING
- 33 A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover
- 34 tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are
- 35 dry.
- 36 B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious
- 37 materials that have become damp.
- 38 C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- 39 D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery
- 40 containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- 41 E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- 42 1.8 FIELD CONDITIONS
- 43 A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at
- 44 end of each day's work. Cover partially completed masonry when construction is not in progress.
- 45 B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after
- 46 building masonry walls or columns.
- 47 C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted.
- 48 Immediately remove grout, mortar, and soil that come in contact with such masonry.
- 49 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground
- 50 and over wall surface.
- 51 2. Protect sills, ledges, and projections from mortar droppings.
- 52 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes,
- 53 from mortar droppings.
- 54 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and
- 55 dirt onto completed masonry.
- 56 D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not
- 57 build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply
- 58 with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

- 1 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and
2 higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
3 E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in
4 TMS 602/ACI 530.1/ASCE 6.
5

6 PART 2 - PRODUCTS
7
8

9 2.1 MANUFACTURERS

- 10 A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform
11 blend within the ranges accepted for these characteristics, from single source from single manufacturer for each
12 product required.
13 B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed
14 masonry, from single manufacturer for each cementitious component and from single source or producer for each
15 aggregate.

16 2.2 PERFORMANCE REQUIREMENTS

- 17 A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
18 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of
19 masonry units and mortar types (unit-strength method) in accordance with TMS 602/ACI 530.1/ASCE 6.

20 2.3 UNIT MASONRY, GENERAL

- 21 A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract
22 Documents.
23 B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips,
24 cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed
25 Work.
26 C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
27 1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing
28 agency acceptable to authorities having jurisdiction.

29 2.4 CONCRETE MASONRY UNITS

- 30 A. Regional Materials: Verify CMUs are manufactured within 100 miles of Project site from aggregates and cement
31 that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
32 B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units
33 unless otherwise indicated.
34 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other
35 special conditions.
36 2. Provide bullnose units for outside corners unless otherwise indicated.
37 C. CMUs: ASTM C90.
38 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
39 2. Density Classification: Normal weight unless otherwise indicated.
40 3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

41 2.5 LINTELS

- 42 A. General: Provide the following:
43 B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent
44 CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse
45 grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

46 2.6 MORTAR AND GROUT MATERIALS

- 47 A. Regional Materials: Manufacture aggregate for mortar and grout, cement, and lime within 100 miles of Project site
48 from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of
49 Project site.
50 B. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction.
51 Provide natural color as required to produce mortar color indicated.
52 C. Hydrated Lime: ASTM C207, Type S.
53 D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
54 E. Aggregate for Mortar: ASTM C144.
55 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
56 2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-
57 mm) sieve.
58 F. Aggregate for Grout: ASTM C404.

- 1 G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M,
2 Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- 3 H. Water: Potable.
- 4 2.7 REINFORCEMENT
- 5 A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, **Grade 60**.
- 6 B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to
7 hold reinforcing bars in center of cells. Units are formed from **0.148-inch** steel wire, hot-dip galvanized after
8 fabrication. Provide units designed for number of bars indicated.
- 9 C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.
- 10 1. Interior Walls: Galvanized carbon steel.
- 11 2. Exterior Walls and interior walls enclosing wet or high moisture areas: Hot-dip galvanized carbon steel.
- 12 3. Wire Size for Side Rods: **0.148-inch** diameter.
- 13 4. Wire Size for Cross Rods: **0.148-inch** diameter.
- 14 5. Spacing of Cross Rods: Not more than **16 inches** o.c.
- 15 6. Provide in lengths of not less than **10 feet**.
- 16 2.8 TIES AND ANCHORS
- 17 A. General: Ties and anchors extend at least **1-1/2 inches** into masonry but with at least a **5/8-inch** cover on outside
18 face.
- 19 B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the
20 following unless otherwise indicated:
- 21 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
- 22 2. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- 23 C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal
24 adjustment but resist tension and compression forces perpendicular to plane of wall.
- 25 1. Anchor Section for Welding to Steel Frame: Crimped **1/4-inch** diameter, hot-dip galvanized steel wire.
- 26 2. Tie Section: Triangular-shaped wire tie made from **0.187-inch** diameter, hot-dip galvanized steel wire.
- 27 D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but
28 resist tension and compression forces perpendicular to plane of wall.
- 29 1. Corrugated-Metal Ties: Metal strips not less than **7/8 inch** wide with corrugations having a wavelength of
30 **0.3 to 0.5 inch** and an amplitude of **0.06 to 0.10 inch** made from **0.060-inch** thick steel sheet, galvanized
31 after fabrication.
- 32 E. Partition Top Anchors: **0.105-inch** thick metal plate with a **3/8-inch** diameter metal rod **6 inches** long welded to
33 plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from
34 steel, hot-dip galvanized after fabrication.
- 35 F. Rigid Anchors: Fabricate from steel bars **1-1/2 inches (38 mm)** wide by **1/4 inch (6.35 mm)** thick by **24 inches (610**
36 **mm)** long, with ends turned up **2 inches (51 mm)** or with cross pins unless otherwise indicated.
- 37 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.
- 38 2.9 MISCELLANEOUS MASONRY ACCESSORIES
- 39 A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent;
40 of width and thickness indicated; formulated from neoprene.
- 41 B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000,
42 Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size
43 and configuration as indicated.
- 44 C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- 45 2.10 MORTAR AND GROUT MIXES
- 46 A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent
47 agents, antifreeze compounds, or other admixtures unless otherwise indicated.
- 48 1. Do not use calcium chloride in mortar or grout.
- 49 2. Use portland cement-lime mortar unless otherwise indicated.
- 50 3. For reinforced masonry, use portland cement-lime mortar.
- 51 4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of
52 weather conditions, to ensure that mortar color is consistent.
- 53 B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by
54 weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- 55 C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for
56 applications stated unless another type is indicated.
- 57 1. For reinforced masonry, use Type S.

- 1 2. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-
2 bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not
3 indicated, use Type N.
4 D. Grout for Unit Masonry: Comply with ASTM C476.
5 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with
6 TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
7 2. Proportion grout in accordance with ASTM C476.
8 3. Provide grout with a slump of **8 to 11 inches** as measured in accordance with ASTM C143/C143M.
9

10 PART 3 - EXECUTION
11

12
13 3.1 EXAMINATION

- 14 A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other
15 conditions affecting performance of the Work.
16 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance
17 of the Work.
18 2. Verify that foundations are within tolerances specified.
19 3. Verify that reinforcing dowels are properly placed.
20 4. Verify that substrates are free of substances that would impair mortar bond.

21 B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

22 C. Proceed with installation only after unsatisfactory conditions have been corrected.

23 3.2 INSTALLATION, GENERAL

24 A. Build chases and recesses to accommodate items specified in this and other Sections.

25 B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete
26 masonry to match construction immediately adjacent to opening.

27 C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining
28 construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before
29 laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges
30 concealed.

31 3.3 TOLERANCES

32 A. Dimensions and Locations of Elements:

- 33 1. For dimensions in cross section or elevation, do not vary by more than plus **1/2 inch** or minus **1/4 inch**.
34 2. For location of elements in plan, do not vary from that indicated by more than plus or minus **1/2 inch**.
35 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus **1/4 inch**
36 in a story height or **1/2 inch** total.

37 B. Lines and Levels:

- 38 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than **1/4 inch in 10 feet**, or
39 **1/2-inch** maximum.
40 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more
41 than **1/8 inch in 10 feet**, **1/4 inch in 20 feet**, or **1/2-inch** maximum.
42 3. For vertical lines and surfaces do not vary from plumb by more than **1/4 inch in 10 feet**, **3/8 inch in 20 feet**,
43 or **1/2-inch** maximum.
44 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control
45 joints, do not vary from plumb by more than **1/8 inch in 10 feet**, **1/4 inch in 20 feet**, or **1/2-inch** maximum.
46 5. For lines and surfaces, do not vary from straight by more than **1/4 inch in 10 feet**, **3/8 inch in 20 feet**, or **1/2-**
47 **inch** maximum.
48 6. For vertical alignment of exposed head joints, do not vary from plumb by more than **1/4 inch in 10 feet**, or
49 **1/2-inch** maximum.
50 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than **1/16 inch**.

51 C. Joints:

- 52 1. For bed joints, do not vary from thickness indicated by more than plus or minus **1/8 inch**, with a maximum
53 thickness limited to **1/2 inch**.
54 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than **1/8 inch**.
55 3. For head and collar joints, do not vary from thickness indicated by more than plus **3/8 inch** or minus **1/4**
56 **inch**.
57 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus **1/8 inch**.

- 1 3.4 LAYING MASONRY WALLS
- 2 A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for
- 3 accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units,
- 4 particularly at corners, jambs, and, where possible, at other locations.
- 5 B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in **running bond**; do not use
- 6 units with less-than-nominal **4-inch** horizontal face dimensions at corners or jambs.
- 7 C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than **4 inches**. Bond
- 8 and interlock each course of each wythe at corners. Do not use units with less-than-nominal **4-inch** horizontal face
- 9 dimensions at corners or jambs.
- 10 D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not
- 11 tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and
- 12 mortar, and wet brick if required before laying fresh masonry.
- 13 E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with
- 14 masonry around built-in items.
- 15 F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- 16 G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh,
- 17 or plastic mesh in the joint below, and rod mortar or grout into core.
- 18 H. Fill cores in hollow CMUs with grout **24 inches** under bearing plates, beams, lintels, posts, and similar items unless
- 19 otherwise indicated.
- 20 I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above
- 21 unless otherwise indicated.
- 22 1. Install compressible filler in joint between top of partition and underside of structure above.
- 23 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly
- 24 around plastic tubes of anchors and push tubes down into grout to provide **1/2-inch** clearance between end
- 25 of anchor rod and end of tube. Space anchors **48 inches** o.c. unless otherwise indicated.
- 26 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint
- 27 with mortar after dead-load deflection of structure above approaches final position.
- 28 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply
- 29 with Section 078443 "Joint Firestopping."
- 30 3.5 MORTAR BEDDING AND JOINTING
- 31 A. Lay hollow CMUs as follows:
- 32 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
- 33 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
- 34 3. Bed webs in mortar in grouted masonry, including starting course on footings.
- 35 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- 36 B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and
- 37 shove into place. Do not deeply furrow bed joints or slush head joints.
- 38 C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless
- 39 otherwise indicated.
- 40 D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless
- 41 otherwise indicated.
- 42 E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.
- 43 3.6 MASONRY-JOINT REINFORCEMENT
- 44 A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of **5/8 inch** on exterior side
- 45 of walls, **1/2 inch** elsewhere. Lap reinforcement a minimum of **6 inches**.
- 46 1. Space reinforcement not more than **16 inches** o.c.
- 47 2. Provide reinforcement not more than **8 inches** above and below wall openings and extending **12 inches**
- 48 beyond openings.
- 49 B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- 50 C. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column
- 51 fireproofing, pipe enclosures, and other special conditions.
- 52 3.7 CONTROL AND EXPANSION JOINTS
- 53 A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow
- 54 materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- 55 B. Form control joints in concrete masonry using one of the following methods:
- 56 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core
- 57 with grout, and rake out joints in exposed faces for application of sealant.
- 58 2. Install preformed control-joint gaskets designed to fit standard sash block.

- 1 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints
2 free and clear of mortar, or rake out joint for application of sealant.
3 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for
4 application of sealant.
5 C. If not shown on plans, provide at maximum 23 feet joint-to-joint and at maximum 12 joint-to-corner in locations to
6 coincide with changes in wall height or thickness, construction joints in foundation, chases or recesses, columns,
7 sides of wall opening, return angles or reentrant corners, as approved by Architect.
8 3.8 LINTELS
9 A. Provide lintels where shown and where openings of more than **12 inches** for brick-size units and **24 inches** for block-
10 size units are shown without structural steel or other supporting lintels.
11 B. Provide minimum bearing of **8 inches** at each jamb unless otherwise indicated.
12 3.9 REINFORCED UNIT MASONRY
13 A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry
14 elements during construction.
15 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms
16 sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position
17 and shape during construction and curing of reinforced masonry.
18 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry
19 their own weight and other loads that may be placed on them during construction.
20 B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
21 C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist
22 grout pressure.
23 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including
24 minimum grout space and maximum pour height.
25 3.10 REPAIRING, POINTING, AND CLEANING
26 A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not
27 match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate
28 evidence of replacement.
29 B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar.
30 Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance.
31 Prepare joints for sealant application, where indicated.
32 C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears
33 before tooling joints.
34 D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
35 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
36 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
37 Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
38 3. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
39 3.11 MASONRY WASTE DISPOSAL
40 A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At
41 completion of unit masonry work, remove from Project site.
42 B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste
43 mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
44 1. Crush masonry waste to less than **4 inches** in each dimension.
45 2. Do not dispose of masonry waste as fill within **18 inches** of finished grade.
46 C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
47 D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or
48 recycled, and other masonry waste, and legally dispose of off Owner's property.
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END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL FRAMING

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Structural-steel materials.
 2. Shrinkage-resistant grout.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

1.5 ACTION SUBMITTALS

- A. Product Data:

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1. Structural-steel materials.
 2. High-strength, bolt-nut-washer assemblies.
 3. Anchor rods.
 4. Threaded rods.
 5. Shop primer.
 6. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Identify members not to be shop primed.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand-critical welds.

21 1.6 INFORMATIONAL SUBMITTALS

- 22 A. Welding certificates.
- 23 B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop
- 24 primers are compatible with topcoats.
- 25 C. Mill test reports for structural-steel materials, including chemical and physical properties.
- 26 D. Product Test Reports: For the following:
- 27 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
- 28 2. Direct-tension indicators.
- 29 3. Tension-control, high-strength, bolt-nut-washer assemblies.
- 30 E. Survey of existing conditions.
- 31 F. Source quality-control reports.
- 32 G. Field quality-control reports.
- 33

34 1.7 QUALITY ASSURANCE

- 35 A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- 36

37 1.8 DELIVERY, STORAGE, AND HANDLING

- 38 A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced
- 39 by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from
- 40 corrosion and deterioration.
- 41 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to
- 42 members or supporting structures. Repair or replace damaged materials or structures as directed.
- 43 B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
- 44 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and
- 45 seals containers.
- 46 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
- 47 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M,
- 48 Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.
- 49

50 PART 2 - PRODUCTS

51 52 2.1 PERFORMANCE REQUIREMENTS

- 53 A. Comply with applicable provisions of the following specifications and documents:
- 54 1. ANSI/AISC 303.
- 55 B. Connection Design Information:
- 56 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.
- 57 2. Option 2: Fabricator's experienced steel detailer selects or completes connections in accordance with
- 58 ANSI/AISC 303.

- 1 a. Select and complete connections using **schematic details indicated**.
2 b. Use **Allowable Stress Design; data are given at service-load level**.
3 C. Moment Connections: **Type PR, partially** restrained.
4

5 **2.2 STRUCTURAL-STEEL MATERIALS**

- 6 A. W-Shapes: **ASTM A992/A992M**.
7 B. Channels, Angles, M-Shapes: **ASTM A36/A36M**.
8 C. Channels, Angles, S-Shapes: **ASTM A36/A36M**.
9 D. Plate and Bar: **ASTM A36/A36M**.
10 E. Cold-Formed Hollow Structural Sections: **ASTM A500/A500M, Grade B** structural tubing.
11 F. Welding Electrodes: Comply with AWS requirements.
12

13 **2.3 BOLTS AND CONNECTORS**

- 14 A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural
15 bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel
16 washers; all with plain finish.
17 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
18

19 **2.4 RODS**

- 20 A. Headed Anchor Rods: **ASTM F1554, Grade 36**, straight.
21 1. Nuts: ASTM A563 hex carbon steel.
22 2. Plate Washers: ASTM A36/A36M carbon steel.
23 3. Washers: ASTM F436, Type 1, hardened carbon steel.
24 4. Finish: **Plain**.
25

26 **2.5 PRIMER**

- 27 A. Steel Primer:
28 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79
29 and compatible with topcoat.
30
31

32 **2.6 SHRINKAGE-RESISTANT GROUT**

- 33 A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout,
34 noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working
35 time.
36

37 **2.7 FABRICATION**

- 38 A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with
39 ANSI/AISC 303 and to ANSI/AISC 360.
40 1. Camber structural-steel members where indicated.
41 2. Fabricate beams with rolling camber up.
42 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until
43 structural-steel framing has been erected.
44 4. Mark and match-mark materials for field assembly.
45 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
46 B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
47 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
48 C. Bolt Holes: Cut, drill, **mechanically thermal cut**, or punch standard bolt holes perpendicular to metal surfaces.
49 D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
50 E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with **SSPC-SP 1**.
51 F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel
52 members.
53 1. Cut, drill, or punch holes perpendicular to steel surfaces. **Do not thermally cut bolt holes or enlarge holes**
54 **by burning**.
55 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
56 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
57

1 **2.8 SHOP CONNECTIONS**

- 2 A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints
3 Using High-Strength Bolts" for type of bolt and type of joint specified.
4 1. Joint Type: **Snug tightened.**
5 B. Weld Connections: Comply with AWS D1.1/D1.1M and **AWS D1.8/D1.8M** for tolerances, appearances, welding
6 procedure specifications, weld quality, and methods used in correcting welding work.
7 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding
8 tolerances in ANSI/AISC 303 for mill material.
9

10
11 **2.9 SHOP PRIMING**

- 12 A. Shop prime steel surfaces, except the following:
13 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2
14 inches.
15 2. Surfaces to be field welded.
16 B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux
17 deposits. Prepare surfaces in accordance with the following specifications and standards:
18 1. SSPC-SP 2.
19 2. SSPC-SP 3.
20 C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written
21 instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming
22 methods that result in full coverage of joints, corners, edges, and exposed surfaces.
23 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
24 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of
25 second coat to distinguish it from first.
26
27

28 **PART 3 - EXECUTION**

29
30 **3.1 EXAMINATION**

- 31 A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of
32 anchor rods, bearing plates, and other embedments for compliance with requirements.
33 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and
34 other embedments showing dimensions, locations, angles, and elevations.
35 B. Proceed with installation only after unsatisfactory conditions have been corrected.
36

37 **3.2 PREPARATION**

- 38 A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb,
39 and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove
40 temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise
41 indicated on Drawings.
42

43 **3.3 ERECTION**

- 44 A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and
45 ANSI/AISC 360.
46 B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing
47 materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
48 1. Set plates for structural members on wedges, shims, or setting nuts as required.
49 2. Weld plate washers to top of baseplate.
50 3. **Snug-tighten** anchor rods after supported members have been positioned and plumbed. Do not remove
51 wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
52 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain.
53 Neatly finish exposed surfaces; protect grout and allow to cure. **Comply with manufacturer's written**
54 **installation instructions for grouting.**
55 C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
56 D. Align and adjust various members that form part of complete frame or structure before permanently fastening.
57 Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform
58 necessary adjustments to compensate for discrepancies in elevations and alignment.

- 1 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on
2 Drawings.
3 E. Splice members only where indicated.
4 F. Do not use thermal cutting during erection **unless approved by Architect. Finish thermally cut sections within**
5 **smoothness limits in AWS D1.1/D1.1M.**
6 G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit
7 bolts.
8

9 3.4 FIELD CONNECTIONS

- 10 A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using
11 High-Strength Bolts" for bolt and joint type specified.
12 1. Joint Type: **Snug tightened.**
13 B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications,
14 weld quality, and methods used in correcting welding work.
15 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections,
16 and removal of paint on surfaces adjacent to field welds.
17 2. Remove backing bars or runoff tabs **where indicated**, back gouge, and grind steel smooth.
18 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding
19 tolerances in ANSI/AISC 303 for mill material.
20
21

22 3.5 REPAIR

- 23 A. Touchup Painting:
24 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the
25 same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
26 a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
27

28 3.6 FIELD QUALITY CONTROL

- 29
30 A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
31 1. Bolted Connections: Inspect **and test** bolted connections in accordance with RCSC's "Specification for
32 Structural Joints Using High-Strength Bolts."
33 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
34 a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M
35 and the following inspection procedures, at testing agency's option:
36 1) Liquid Penetrant Inspection: ASTM E165/E165M.
37 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld.
38 Cracks or zones of incomplete fusion or penetration are not accepted.
39 3) Ultrasonic Inspection: ASTM E164.
40 4) Radiographic Inspection: ASTM E94/E94M.
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SECTION 05 40 00
COLD-FORMED METAL FRAMING

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28

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Exterior non-load-bearing wall framing.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Cold-formed steel framing materials.
2. Exterior non-load-bearing wall framing.
B. Shop Drawings:
1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
C. Delegated Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
B. Product Certificates: For each type of code-compliance certification for studs and tracks.
C. Product Test Reports: For each listed product, for tests performed by **manufacturer and witnessed by a qualified testing agency**.
1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.

- 1 6. Horizontal drift deflection clips
- 2 7. Miscellaneous structural clips and accessories.
- 3 D. Research Reports:
- 4 1. For nonstandard cold-formed steel framing [**post-installed anchors**] [**and**] [**power-actuated fasteners**],
- 5 from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
- 6 2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.
- 7

8 **1.5 QUALITY ASSURANCE**

- 9 A. Product Tests: Mill certificates or data from a qualified independent testing agency, **or in-house testing with**
- 10 **calibrated test equipment**, indicating steel sheet complies with requirements, including base-metal thickness, yield
- 11 strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- 12 B. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified
- 13 according to the product-certification program of **the Certified Steel Stud Association**.
- 14 C. Welding Qualifications: Qualify procedures and personnel according to the following:
- 15 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 16 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- 17

18 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 19 A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage
- 20 during delivery, storage, and handling as required in AISI S202.
- 21

22 **PART 2 - PRODUCTS**

23

24

25 **2.1 PERFORMANCE REQUIREMENTS**

- 26 A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements,"
- 27 to design cold-formed steel framing.
- 28 B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and
- 29 under conditions indicated.
- 30 1. Design Loads: **As indicated on Drawings**.
- 31 2. Deflection Limits: Design framing systems to withstand **design loads** without deflections greater than the
- 32 following:
- 33 a. Exterior Non-Load-Bearing Framing: Horizontal deflection of **1/360** of the wall height.
- 34 3. Design framing systems to provide for movement of framing members located outside the insulated
- 35 building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on
- 36 fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature
- 37 change of 120 deg F.
- 38 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to
- 39 accommodate live load deflection of primary building structure as follows:
- 40 a. Upward and downward movement of **1/2 inch**.
- 41
- 42 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for
- 43 contribution of sheathing materials.
- 44 C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with
- 45 AISI S100 and **ASTM C955**.
- 46 D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with
- 47 appropriate markings of applicable testing agency.
- 48 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified
- 49 testing agency acceptable to authorities having jurisdiction.
- 50

51 **2.2 COLD-FORMED STEEL FRAMING MATERIALS**

- 52 A. Framing Members, General: Comply with **ASTM C955** for conditions indicated.
- 53 B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as
- 54 follows:
- 55 1. Grade: **As required by structural performance**
- 56 2. Coating: **G60, A60, AZ50, or GF30**
- 57 C. Steel Sheet for **Vertical Deflection** Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as
- 58 follows:

- 1 1. Grade: **As required by structural performance**
- 2 2. Coating: **G60**

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- 5 A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened
6 flanges, and as follows:
 - 7 1. Minimum Base-Metal Thickness: **0.0538 inch.**
 - 8 2. Flange Width: **1-5/8 inches.**
- 9 B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened
10 flanges, and as follows:
 - 11 1. Minimum Base-Metal Thickness: **0.0329 inch.**
 - 12 2. Flange Width: **1-1/4 inches.**
- 13 C. Vertical Deflection Clips, Exterior: Manufacturer's standard **head** clips, capable of accommodating upward and
14 downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- 15 D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges,
16 of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal
17 loads and transfer them to the primary structure, and as follows:
 - 18 1. Minimum Base-Metal Thickness: **0.0428 inch.**
 - 19 2. Flange Width: **1 inch plus the design gap for one-story structures.**
- 20 E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward
21 vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and
22 structure.

2.4 FRAMING ACCESSORIES

- 25 A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel
26 sheet, of same grade and coating designation used for framing members.
- 27 B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 28
 - 29 1. Supplementary framing.
 - 30 2. Bracing, bridging, and solid blocking.
 - 31 3. Web stiffeners.
 - 32 4. Anchor clips.
 - 33 5. End clips.
 - 34 6. Foundation clips.
 - 35 7. Gusset plates.
 - 36 8. Stud kickers and knee braces.
 - 37 9. Joist hangers and end closures.
 - 38 10. Hole-reinforcing plates.
 - 39 11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

- 42 A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- 43 B. Anchor Bolts: ASTM F1554, **Grade 36**, threaded carbon-steel **hex-headed bolts**, carbon-steel nuts, and flat,
44 hardened-steel washers; zinc coated by **hot-dip process according to ASTM A153/A153M, Class C.**
- 45 C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless
46 otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation
47 report acceptable to authorities having jurisdiction, based on **ICC-ES AC01** as appropriate for the substrate.
 - 48 1. Uses: Securing cold-formed steel framing to structure.
 - 49 2. Type: **Torque-controlled expansion anchor.**
 - 50 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or
51 ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - 52 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy **Group 1** stainless
53 steel bolts, ASTM F593, and nuts, ASTM F594.
- 54 D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load,
55 according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- 56 E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 57 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- 58 F. Welding Electrodes: Comply with AWS standards.

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2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: **ASTM A780/A780M**.
- B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.
- F. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil nominal thickness, self-adhering sheet consisting of 64 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side.
 - 1. Physical Properties:
 - a. Peel Adhesion: 17.0 lb/in of width when tested in accordance with ASTM D412.
 - b. Low-Temperature Flexibility: Pass at minus 25 deg F when tested in accordance with ASTM D146/D146M.
 - c. Water Vapor Permeance: 0.05 perm maximum when tested in accordance with ASTM E96/E96M, Method B.
 - d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.7 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

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3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to **top and** bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: **16 inches**.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to **infill** studs and anchor to building structure.
 - 4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated **on Shop Drawings** but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within **12 inche** of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at **centers indicated on Shop Drawings**.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

- 1 **3.6 REPAIR**
- 2 A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel
- 3 framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- 4
- 5 **3.7 FIELD QUALITY CONTROL**
- 6 A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and
- 7 inspections and prepare test reports.
- 8 B. Field and shop welds will be subject to testing and inspecting.
- 9 C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- 10 D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- 11 E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced
- 12 or additional work with specified requirements.
- 13
- 14 **3.8 PROTECTION**
- 15 A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure
- 16 that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.
- 17
- 18

END OF SECTION

**SECTION 05 50 00
METAL FABRICATIONS**

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40			
41	1.1 SUMMARY		
42	A. Section includes:		
43	1. Miscellaneous framing and supports.		
44	2. Alternating tread devices.		
45	3. Metal floor plate.		
46	4. Miscellaneous steel trim.		
47	5. Plank Grating		
48	6. Metal bollards.		
49	7. Fuel island edging		
50	8. Metal tire rests.		
51	9. Loose bearing and leveling plates.		
52	B. Products furnished, but not installed, under this Section include the following:		
53	1. Loose steel lintels.		
54	2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.		
55			
56	C. Related Requirements:		
57	1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.		
58			

- 1 2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist
2 beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
- 3 1.2 COORDINATION
- 4 A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating
5 manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- 6 B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting
7 drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and
8 items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in
9 time for installation.
- 10 1.3 SUBMITTALS
- 11 A. Product Data:
- 12 1. Nonslip aggregates and nonslip-aggregate surface finishes.
- 13 2. Fasteners.
- 14 3. Shop primers.
- 15 4. Shrinkage-resisting grout.
- 16 5. Slotted channel framing.
- 17 6. Alternating tread devices.
- 18 7. Metal bollards.
- 19 B. Shop Drawings: Show fabrication and installation details. Provide Shop Drawings for the following:
- 20 1. Miscellaneous framing and supports for applications where framing and supports are not specified in other
21 Sections.
- 22 2. Alternating tread devices.
- 23 3. Miscellaneous steel trim.
- 24 4. Fall Protection
- 25 5. Plank Grating
- 26 6. Metal bollards.
- 27 7. Metal tire rests.
- 28 8. Loose steel lintels.
- 29 C. Delegated Design Submittals: For **alternating tread devices**, including analysis data signed and sealed by the
30 qualified professional engineer responsible for their preparation.
- 31 D. Sustainable Design Submittals:
- 32 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- 33 2. Regional Materials: Manufacture products within **100 miles** of Project site from materials that have been
34 extracted, harvested, or recovered, as well as manufactured, within **100 miles** of Project site.
- 35 3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- 36 E. Welding certificates.
- 37 F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop
38 primers are compatible with topcoats.
- 39 G. Research Reports: For post-installed anchors.
- 40 H. Delegated design engineer qualifications.
- 41 1.4 QUALITY ASSURANCE
- 42 A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
- 43 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 44 B. Workmanship and finish shall be first class and equal to best practice in modern fabrication shops. Shearing,
45 clipping and burning shall be neatly and accurately done and all portions of work exposed to view shall be neatly
46 finished.
- 47 1.5 FIELD CONDITIONS
- 48 A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with
49 metal fabrications by field measurements before fabrication.
- 50
- 51 PART 2 - PRODUCTS
- 52
- 53
- 54 2.1 PERFORMANCE REQUIREMENTS
- 55 A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements,"
56 to design **alternating tread devices**.
- 57 B. Structural Performance of Alternating Tread Devices: Alternating tread devices are to withstand the effects of
58 gravity loads and the following loads and stresses within limits and under conditions indicated:

- 1 1. Uniform Load: **100 lbf/sq. ft.**
- 2 2. Concentrated Load: **300 lbf** applied on an area of **4 sq. in.**
- 3 3. Uniform and concentrated loads need not be assumed to act concurrently.
- 4 4. Capacity: Unit shall support a 1,000 lb (227 kg) total load without failure.
- 5 5. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition
- 6 to loads specified above.
- 7 6. Comply with applicable railing loadings in Section 055213 "Pipe and Tube Railings."
- 8 C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- 9 2.2 METALS
- 10 A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal
- 11 fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled
- 12 trade names, or blemishes.
- 13 B. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- 14 C. Regional Materials: Manufacture products within **100 miles** of Project site from materials that have been extracted,
- 15 harvested, or recovered, as well as manufactured, within **100 miles** of Project site.
- 16 D. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- 17 E. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, **Type 304**.
- 18 F. Stainless Steel Bars and Shapes: ASTM A276/A276M, **Type 304**.
- 19 G. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or
- 20 ASTM A283/A283M, Grade C or D.
- 21 H. Rolled-Stainless Steel Floor Plate: ASTM A793.
- 22 I. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- 23 J. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- 24 K. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
- 25 1. Size of Channels: **1-5/8 by 1-5/8 inches** or as indicated.
- 26 2. Galvanized Steel: ASTM A653/A653M, with **G90** coating; **0.108-inch, 0.079-inch, or 0.064-inch** nominal
- 27 thickness as required.
- 28 3. Cold-Rolled Steel: ASTM A1008/A1008M, **0.0966-inch, 0.0677-inch, or 0.0528-inch** minimum thickness;
- 29 coated with rust-inhibitive, baked-on, acrylic enamel.
- 30 L. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- 31 2.3 FASTENERS
- 32 A. General: Unless otherwise indicated, provide **Type 304** stainless steel fasteners for exterior use and zinc-plated
- 33 fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select
- 34 fasteners for type, grade, and class required.
- 35 1. Provide stainless steel fasteners for fastening **stainless steel**.
- 36 2. Provide bronze fasteners for fastening bronze.
- 37 B. Steel Bolts and Nuts: Regular hexagon-head bolts, **ASTM A307, Grade A (ISO 898-1, Property Class 4.6)**; with hex
- 38 nuts, **ASTM A563 (ASTM A563M)**; and, where indicated, flat washers.
- 39 C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325 (Grade A325M)**, Type 3, heavy-hex steel
- 40 structural bolts; **ASTM A563, Grade DH3, (ASTM A563M, Class 10S3)** heavy-hex carbon-steel nuts; and where
- 41 indicated, flat washers.
- 42 D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, **ASTM F593 (ISO 3506-1)**; with
- 43 hex nuts, **ASTM F594 (ASTM F836M)**; and, where indicated, flat washers; Alloy **Group 1 (A1)**.
- 44 E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, **ASTM A563 (ASTM A563M)**; and, where
- 45 indicated, flat washers.
- 46 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to
- 47 be galvanized.
- 48 F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous
- 49 castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as
- 50 needed, all hot-dip galvanized per ASTM F2329/F2329M.
- 51 G. Post-Installed Anchors: **Torque-controlled expansion anchors or chemical anchors**.
- 52 1. Material for Interior and Exterior Locations and Where Stainless Steel Is Indicated: Alloy **Group 1 (A1)**
- 53 stainless steel bolts, **ASTM F593 (ISO 3506-1)**, and nuts, **ASTM F594 (ASTM F836M)**.
- 54 2.4 MISCELLANEOUS MATERIALS
- 55 A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior
- 56 Painting," and Section 099600 "High-Performance Coatings."
- 57 B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with
- 58 finish paint systems indicated.

- 1 C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints
2 specified to be used over it.
- 3 D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- 4 E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying
5 with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior
6 applications.
- 7 F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained
8 concrete with a minimum 28-day compressive strength of **3000 psi**.
- 9 2.5 FABRICATION, GENERAL
- 10 A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for
11 shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark
12 units for reassembly and coordinated installation.
- 13 B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32**
14 **inch** unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- 15 C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- 16 D. Form exposed work with accurate angles and surfaces and straight edges.
- 17 E. Weld corners and seams continuously to comply with the following:
- 18 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base
19 metals.
- 20 2. Obtain fusion without undercut or overlap.
- 21 3. Remove welding flux immediately.
- 22 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows
23 after finishing **and contour of welded surface matches that of adjacent surface**.
- 24 F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where
25 possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise
26 indicated. Locate joints where least conspicuous.
- 27 G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep
28 holes where water may accumulate.
- 29 H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- 30 I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure
31 metal fabrications rigidly in place and to support indicated loads.
- 32 J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap
33 anchors, **1/8 by 1-1/2 inches**, with a minimum **6-inch** embedment and **2-inch** hook, not less than **8 inches** from ends
34 and corners of units and **24 inches** o.c., unless otherwise indicated.
- 35 2.6 MISCELLANEOUS FRAMING AND SUPPORTS
- 36 A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- 37 B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to
38 sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- 39 1. Fabricate units from slotted channel framing where indicated.
- 40 2. Furnish inserts for units installed after concrete is placed.
- 41 2.7 ALTERNATING TREAD DEVICES
- 42 A. Alternating Tread Devices: Fabricate alternating tread devices of open-type construction with channel or plate
43 stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
- 44 1. Acceptable manufactures include but are not limited to Precision Ladders, LLC.
- 45 2. Tread depth is not to be less than **5 inches** exclusive of nosing or less than **8-1/2 inches**, including the
46 nosing, tread width is not to be less than **7 inches**, and riser height is not to be more than **9-1/2 inches**.
- 47 a. For use to access an unoccupied roof.
- 48 3. Tread depth is not to be less than **8-1/2 inches** exclusive of nosing or less than **10-1/2 inches**, including the
49 nosing, tread width is not to be less than **7 inches**, and riser height is not to be more than **8 inches**.
- 50 a. For use as an element of a means of egress.
- 51 4. Fabricate from **aluminum** and assemble by welding or with stainless steel fasteners.
- 52 5. Handrails: 1-1/4 inches Schedule 40, 6005-T5 aluminum pipe provided with internal aluminum fittings.
- 53 B. Landing & Foot Stampings: 11 Gauge; Minimum 36 ksi yield stress; AISI 1010/15 or ASTM A1011 structural steel (SS)
54 type grade 36 (or higher).
- 55 C. Top Landing Support Clips: Formed L2 x 2 x 1/4" x 4" lg. with 5/8" Φ round holes and 5/8" x 1" slot holes, ASTM A1011
56 structural steel (SS) Type, grade 36 (or higher) Performance Standard: Units designed and manufactured to meet or
57 exceed OSHA 1910.25.
- 58 D. Finishes:

- 1 1. Standard: Mill finish on aluminum stair components.
- 2 E. WARRANTY
- 3 1. Limited Warranty: Five years against defective material and workmanship
- 4 2.8 METAL FLOOR PLATE
- 5 A. Fabricate from **rolled-steel floor** plate of thickness indicated below:
- 6 1. Thickness: **1/4 inch**.
- 7 B. Provide **steel** angle supports as indicated.
- 8 C. Include **steel** angle stiffeners, and fixed and removable sections as indicated.
- 9 2.9 MISCELLANEOUS STEEL TRIM
- 10 A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously
- 11 welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- 12 B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- 13 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- 14 C. Galvanize **and prime** miscellaneous steel trim.
- 15 D. Prime miscellaneous steel trim with **primer specified in Section 099600 "High-Performance Coatings."**
- 16 2.10 PLANK GRATING
- 17 A. Roll formed steel plank
- 18 1. Depth; 1 1/2 inches minimum.
- 19 2. Class: 35-B for heavy duty use.
- 20 3. Maximum deflection; 0.375 inches with 300 lb point load.
- 21 4. Maximum deflection; L/180 with uniform load = 20psf.
- 22 5. Minimum strength; Support uniform load of 60 psf.
- 23 6. Galvanized G90.
- 24 2.11 METAL BOLLARDS
- 25 A. Fabricate metal bollards from **Schedule 80 steel pipe**.
- 26 B. Fabricate bollards with **3/8-inch- (9.5-mm-)** thick, **steel** baseplates for bolting to concrete slab where indicated. Drill
- 27 baseplates at all four corners for **3/4-inch (19-mm)** anchor bolts.
- 28 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of
- 29 bollards.
- 30 C. Prime steel bollards with **zinc-rich primer**.
- 31 2.12 FUEL ISLAND EDGING
- 32 1. Manufacture: Riverside Steel, Inc., OPW, Burtco, or equal.
- 33 2. Material: 304 stainless steel.
- 34 3. Gauge: 12 gauge
- 35 4. 2 Piece island with flanged seams on the ends
- 36 5. Corner detail: 6-inch radius.
- 37 6. Height: 9-inches, 12-inches or as needed for accessibility requirements.
- 38 7. Full 1.25 inch bead at the top of the form
- 39 2.13 METAL TIRE RESTS
- 40 A. Fabricate metal rests from **Schedule 80 steel pipe**.
- 41 B. Fabricate bollards with **3/8-inch- (9.5-mm-)** thick, **steel** baseplates for bolting to concrete slab where indicated. Drill
- 42 baseplates at all four corners for **3/4-inch (19-mm)** anchor bolts.
- 43 1. Where rests are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- 44 C. Prime steel bollards with **zinc-rich primer**.
- 45 2.14 LOOSE BEARING AND LEVELING PLATES
- 46 A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to
- 47 receive anchor bolts and for grouting.
- 48 B. Galvanize bearing and leveling plates.
- 49 C. Prime plates with **zinc-rich primer**.
- 50 2.15 STEEL WELD PLATES AND ANGLES
- 51 A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction
- 52 as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors
- 53 for embedding in concrete.
- 54 2.16 GENERAL FINISH REQUIREMENTS
- 55 A. Finish metal fabrications after assembly.
- 56 B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

- 1 2.17 STEEL AND IRON FINISHES
- 2 A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware
- 3 and with ASTM A123/A123M for other steel and iron products.
- 4 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- 5 B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease,
- 6 dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- 7 C. Shop prime iron and steel items[**not indicated to be galvanized**] unless they are to be embedded in concrete,
- 8 sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- 9 1. Shop prime with **primers specified in Section 099113 "Exterior Painting" and primers specified in**
- 10 **Section 099123 "Interior Painting"**.
- 11 D. Preparation for Shop Priming: Prepare surfaces to comply with **requirements indicated below:**
- 12 1. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- 13 2. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
- 14 3. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel,
- 15 Stainless Steels, and Non-Ferrous Metals."
- 16 E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and
- 17 Maintenance Painting of Steel," for shop painting.
- 18 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

19 PART 3 - EXECUTION

- 20
- 21
- 22 3.1 INSTALLATION, GENERAL
- 23 A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set
- 24 metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and
- 25 free of rack; and measured from established lines and levels.
- 26 B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as
- 27 exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces
- 28 of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- 29 C. Field Welding: Comply with the following requirements:
- 30 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base
- 31 metals.
- 32 2. Obtain fusion without undercut or overlap.
- 33 3. Remove welding flux immediately.
- 34 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows
- 35 after finishing and contour of welded surface matches that of adjacent surface.
- 36 D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required
- 37 to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts,
- 38 toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- 39 E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar
- 40 construction.
- 41 F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry,
- 42 wood, or dissimilar metals with the following:
- 43 1. Cast Aluminum: Heavy coat of bituminous paint.
- 44 2. Extruded Aluminum: Two coats of clear lacquer.
- 45 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS
- 46 A. General: Install framing and supports to comply with requirements of items being supported, including
- 47 manufacturers' written instructions and requirements indicated on Shop Drawings.
- 48 3.3 INSTALLATION OF ALTERNATING TREAD DEVICES
- 49 A. Secure top and bottom of alternating tread devices to construction to comply with manufacturer's written
- 50 instructions.
- 51 3.4 INSTALLATION OF METAL FLOOR PLATE
- 52 A. Install metal floor plates flush with finished surface. Adjust as required to avoid lippage that could present a tripping
- 53 hazard.
- 54 3.5 INSTALLATION OF MISCELLANEOUS STEEL TRIM
- 55 A. Anchor to concrete construction to comply with manufacturer's written instructions.
- 56 3.6 INSTALLATION OF METAL BOLLARDS
- 57 A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- 58 1. Do not fill removable bollards with concrete.

- 1 B. Anchor bollards in concrete **in formed or core-drilled holes**. Fill annular space around bollard solidly with shrinkage-
- 2 resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up
- 3 approximately **1/8 inch (3 mm)** toward bollard.
- 4 C. Fill bollards solidly with concrete, mounding top surface to shed water.
- 5 1. Do not fill removable bollards with concrete.
- 6 3.7 INSTALLATION OF TIRE RESTS
- 7 A. Anchor rests to existing construction with **expansion anchors or anchor bolts**. Provide four **3/4-inch (19-mm)** bolts
- 8 at each bollard unless otherwise indicated.
- 9 1. Embed anchor bolts at least **4 inches (100 mm)** in concrete.
- 10 3.8 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES
- 11 A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to
- 12 surfaces. Clean bottom surface of plates.
- 13 B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and
- 14 plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing
- 15 plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to
- 16 ensure that no voids remain.
- 17 3.9 REPAIRS
- 18 A. Touchup Painting:
- 19 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are
- 20 specified in **Section 099113 "Exterior Painting"** and **Section 099123 "Interior Painting."**
- 21 B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with
- 22 ASTM A780/A780M.
- 23
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- 25

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**SECTION 05 52 13
GUARDRAILS**

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19 PART 1 – GENERAL

- 20
21 1.1 SUMMARY
22 A. Section includes maintenance repainting as follows:
23 1. Steel guardrails.
24 1.2 ACTION SUBMITTALS
25 A. Product Data:
26 1. Manufacturer's product lines of mechanically connected railings.
27 2. Shop primer.
28 B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
29

30 PART 2 - PRODUCTS

- 31
32
33 2.1 PERFORMANCE REQUIREMENTS
34 A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of
35 gravity loads and the following loads and stresses within limits and under conditions indicated:
36 1. Top Rails of Guards:
37 a. Uniform load of 50 lbf/ ft. applied in any direction.
38 b. Concentrated load of 200 lbf applied in any direction.
39 c. Uniform and concentrated loads need not be assumed to act concurrently.
40 2. Infill of Guards:
41 a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
42 b. Infill load and other loads need not be assumed to act concurrently.
43 2.2 METALS, GENERAL
44 A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade
45 names, stains, discolorations, or blemishes.
46 B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless
47 otherwise indicated.
48 2.3 STEEL RAILINGS
49 A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
50 B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight
51 are required by structural loads.
52 1. Provide galvanized finish for exterior installations and where indicated.
53 C. Plates, Shapes, and Bars: ASTM A36/A36M.
54 D. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise
55 indicated.
56 2.4 FASTENERS
57 A. General: Provide Type 304 stainless steel fasteners for exterior use.
58 1. Select fasteners for type, grade, and class required.

- 1 B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class
2 required to produce connections suitable for anchoring railings and guards to other types of construction
3 indicated and capable of withstanding design loads.
- 4 C. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according
5 to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
- 6 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel
7 bolts, ASTM F593, and nuts, ASTM F594.
- 8 2.5 MISCELLANEOUS MATERIALS
- 9 A. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- 10 1. For railings, provide type and alloy as recommended by producer of metal to be welded and as required for
11 color match, strength, and compatibility in fabricated items.
- 12 B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with
13 finish paint systems indicated.
- 14 2.6 FABRICATION
- 15 A. Fabricate guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes,
16 including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that
17 needed to withstand indicated loads.
- 18 1. Rails and Posts: 2-inch- square, top rail and 2-inch- square posts.
19 2. Picket Infill: 3/4-inch- round pickets spaced to prohibit the passage of a 4-inch diameter sphere.
- 20 B. Cut, drill, and punch metals cleanly and accurately.
- 21 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
22 2. Remove sharp or rough areas on exposed surfaces.
- 23 C. Form work true to line and level with accurate angles and surfaces.
- 24 D. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose.
25 Weld all around at connections, including at fittings.
- 26 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base
27 metals.
- 28 2. Obtain fusion without undercut or overlap.
29 3. Remove flux immediately.
30 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards"
31 for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay
- 32 E. Form changes in direction as follows:
- 33 1. By bending or by inserting prefabricated elbow fittings.
- 34 F. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of
35 member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of
36 components.
- 37 G. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as
38 railings.
- 39 H. Brackets, Flanges, Fittings, and Anchors: Provide brackets, flanges, miscellaneous fittings, and anchors to
40 interconnect railing members to other work unless otherwise indicated.
- 41 I. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
- 42 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
43 2. Coordinate anchorage devices with supporting structure.
- 44 2.7 STEEL AND IRON FINISHES
- 45 A. Galvanized Railings:
- 46 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
47 2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
48 3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
- 49 B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous
50 components.
- 51 C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux,
52 and other foreign matter, and treat with etching cleaner.
- 53 1. Comply with SSPC-SP 16.
- 54 D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with
55 requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or
56 masonry.
- 57 1. Shop prime uncoated railings with primers specified in Section 099113 "Exterior Painting".
58

1 PART 3 - EXECUTION

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4 **3.1** INSTALLATION, GENERAL

5 A. Perform cutting, drilling, and fitting required for installing railings.

6 1. Fit exposed connections together to form tight, hairline joints.

7 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.

8 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.

9 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and
10 that are intended for field connection by mechanical or other means without further cutting or fitting.

11 5. Set posts plumb within a tolerance of **1/16 inch in 3 feet (2 mm in 1 m)**.

12 **3.2** CLEANING

13 A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

14 B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply
15 with ASTM A780/A780M.

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**SECTION 06 10 00
ROUGH CARPENTRY**

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17
18 PART 1 – GENERAL
19
20 1.1 SUMMARY
21 A. Section Includes:
22 1. Wood products.
23 2. Miscellaneous lumber.
24 1.2 DEFINITIONS
25 A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
26 B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least
27 dimension.
28 C. Lumber grading agencies, and abbreviations used to reference them, include the following:
29 1. NeLMA: Northeastern Lumber Manufacturers' Association.
30 2. NLGA: National Lumber Grades Authority.
31 3. SPIB: The Southern Pine Inspection Bureau.
32 4. WCLIB: West Coast Lumber Inspection Bureau.
33 5. WWPA: Western Wood Products Association.
34 1.3 SUBMITTALS
35 A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and
36 dimensions and include construction and application details.
37 B. Sustainable Design Submittals:
38 1. Chain-of-Custody Qualification Data: For manufacturer and vendor.
39 C. Material Certificates:
40 1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate
41 species and grade selected for each use and design values approved by the ALSC Board of Review.
42 1.4 QUALITY ASSURANCE
43 A. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being
44 invoiced.
45 B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
46
47 PART 2 - PRODUCTS
48
49
50 2.1 WOOD PRODUCTS
51 A. Regional Materials: Manufacture wood products within 100 miles of Project site from materials that have been
52 extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
53 B. Maximum Moisture Content:
54 1. Boards: 19 percent.
55 2. Dimension Lumber: 19 percent unless otherwise indicated.
56

- 1 2.2 MISCELLANEOUS LUMBER
2 A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the
3 following:
4 1. Blocking.
5 2. Nailers.
6 B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any species.
7 C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be
8 used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
9 2.3 FASTENERS
10 A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for
11 material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than **1-1/2 inches** into
12 wood substrate.
13 1. Where rough carpentry is in areas of high relative humidity, provide fasteners with hot-dip zinc coating
14 complying with ASTM A153/A153M or ASTM F2329.
15 B. Nails, Brads, and Staples: ASTM F1667.
16 C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction,
17 based on ICC-ES AC70.
18 D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction,
19 based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
20

21 PART 3 - EXECUTION
22
23

- 24 3.1 INSTALLATION
25 A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry
26 accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for
27 attaching other construction.
28 B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and
29 trim.
30 3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS
31 A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required
32 for true line and level of attached work. Coordinate locations with other work involved.
33 B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless
34 otherwise indicated.
35
36

END OF SECTION

**SECTION 06 41 16
 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**

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 23 3.3 ADJUSTING AND CLEANING 4
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25 PART 1 – GENERAL
 26
 27 1.1 SUMMARY
 28 A. Section Includes:
 29 1. Plastic-laminate-clad architectural cabinets.
 30 2. Cabinet hardware and accessories.
 31 3. Miscellaneous materials.
 32 B. Related Requirements:
 33 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for
 34 installing cabinets that are concealed within other construction before cabinet installation.
 35 2. Section 096513 "Resilient Base and Accessories" for resilient base at cabinet bases.
 36 1.2 COORDINATION
 37 A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work
 38 specified in other Sections to support loads imposed by installed and fully loaded cabinets.
 39 1.3 ACTION SUBMITTALS
 40 A. Product Data:
 41 1. Plastic-laminate-clad architectural cabinets.
 42 2. Cabinet hardware and accessories.
 43 3. Miscellaneous materials.
 44 B. Product Data Submittals: For each product.
 45 C. Sustainable Design Submittals:
 46
 47 1. Regional Materials: Manufacture wood products within 100 miles of Project site from materials that have
 48 been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
 49 2. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of
 50 Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions
 51 from Indoor Sources Using Environmental Chambers."
 52 a. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting
 53 materials.
 54 3. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as
 55 defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde
 56 Emissions from Composite Wood Products," or are made with no added formaldehyde.
 57 a. Laboratory Test Reports: For composite wood products, indicating compliance with requirements
 58 for low-emitting materials.

- 1 D. Shop Drawings:
- 2 1. Include plans, elevations, sections, and attachment details.
- 3 2. Show large-scale details.
- 4 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and
- 5 reinforcement specified in other Sections.
- 6 4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
- 7 E. Samples for Initial Selection: For each type of exposed finish.
- 8 1.4 INFORMATIONAL SUBMITTALS
- 9 A. Qualification Data: For Installer.
- 10 B. Product Certificates: For each type of product.
- 11 1.5 QUALITY ASSURANCE
- 12 A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for
- 13 this Project and whose products have a record of successful in-service performance.
- 14 1.6 DELIVERY, STORAGE, AND HANDLING
- 15 A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have
- 16 been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions
- 17 comply with requirements specified in "Field Conditions" Article.
- 18 1.7 FIELD CONDITIONS
- 19 A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and
- 20 HVAC system is operating and maintaining temperature between **60 and 90 deg F** and relative humidity between 25
- 21 and 55 percent during the remainder of the construction period.
- 22 B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other
- 23 construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate
- 24 fabrication schedule with construction progress to avoid delaying the Work.
- 25 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements
- 26 before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- 27
- 28 PART 2 - PRODUCTS
- 29
- 30
- 31 2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS
- 32 A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of
- 33 cabinets indicated for construction, finishes, installation, and other requirements.
- 34 1. Provide labels and certificates from certification program indicating that woodwork complies with
- 35 requirements of grades specified.
- 36 2. The Contract Documents contain requirements that are more stringent than the referenced quality
- 37 standard. Comply with requirements of Contract Documents in addition to those of the referenced quality
- 38 standard.
- 39 B. Architectural Woodwork Standards Grade: Custom.
- 40 C. Regional Materials: Manufacture wood products within 100 miles of Project site from materials that have been
- 41 extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- 42 D. Type of Construction: Frameless.
- 43 E. Door and Drawer-Front Style: Flush overlay.
- 44 F. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality
- 45 standard.
- 46 G. Exposed Surfaces:
- 47 1. Plastic-Laminate Grade: VGS.
- 48 2. Edges: PVC tape, **0.018-inch** minimum thickness, matching laminate in color, pattern, and finish.
- 49 3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels
- 50 H. Semiexposed Surfaces:
- 51 1. Surfaces Other Than Drawer Bodies: Thermally fused laminate panels.
- 52 a. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
- 53 b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-
- 54 pressure decorative laminate, ISO 4586-3, grade to match exposed surface.
- 55 2. Drawer Sides and Backs: Solid-hardwood lumber.
- 56 3. Drawer Bottoms: Hardwood plywood.
- 57 I. Dust Panels: **1/4-inch** plywood or tempered hardboard above compartments and drawers unless located directly
- 58 under tops.

- 1 J. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3,
2 grade to match exposed surface.
- 3 K. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of
4 body.
 - 5 1. Join subfronts, backs, and sides with glued dovetail joints.
- 6 L. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate
7 surfaces complying with the following requirements:
 - 8 1. Match Architect's sample.
- 9 2.2 SHELVING
- 10 A. Closet and utility shelving: **3/4 inch** thick Particleboard.
 - 11 1. Thermoset decorative particleboard panels with applied 3mm PVC edge banding.
- 12 2.3 WOOD MATERIALS
- 13 A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of
14 architectural cabinet and quality grade specified unless otherwise indicated.
 - 15 1. Wood Moisture Content: 5 to 10 percent.
- 16 B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for
17 each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 18 1. Certified Wood: Certify wood products as "FSC Pure" [or "FSC Mixed Credit"] in accordance with FSC STD-
19 01-001 and FSC STD-40-004.
 - 20 2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as
21 defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde
22 Emissions from Composite Wood Products," or are made with no added formaldehyde.
 - 23 3. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
 - 24 4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-
25 impregnated decorative paper and complying with requirements of ISO 4586.
- 26 2.4 CABINET HARDWARE AND ACCESSORIES
- 27 A. Butt Hinges: **2-3/4-inch**, five-knuckle steel hinges made from **0.095-inch**- thick metal, and as follows:
 - 28 1. Semiconcealed Hinges for Overlay Doors: ANSI/BHMA A156.9, B01521.
- 29 B. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
- 30 C. Wire Pulls: Back mounted, solid metal, **4 inches** long, **5/16 inch** in diameter.
- 31 D. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
- 32 E. Shelf Rests: ANSI/BHMA A156.9, B04013; two-pin plastic with shelf hold-down clip.
- 33 F. Drawer Slides: ANSI/BHMA A156.9.
 - 34 1. Standard Duty (Grade 1 and Grade 2): Side mount.
 - 35 2. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
 - 36 a. Type: Partial extension.
 - 37 b. Material: Zinc-plated ball bearing slides.
 - 38 3. Pencil drawers not more than **3 inches** high and not more than **24 inches** wide, provide **50 lb** load capacity.
 - 39 4. General-purpose drawers more than **3 inches** high, but not more than **6 inches** high and not more than **24**
40 **inches** wide, provide **75 lb** load capacity.
 - 41 5. File drawers more than **6 inches** high or more than **24 inches** wide, provide **100 lb** load capacity.
 - 42 6. Lateral file drawers more than **6 inches** high and more than **24 inches** but not more than **30 inches** wide,
43 provide **150 lb** load capacity.
 - 44 7. Lateral file drawers more than **6 inches** high and more than **30 inches** wide, provide **200 lb** load capacity.
- 45 G. Door Locks: ANSI/BHMA A156.11, E07121.
- 46 H. Drawer Locks: ANSI/BHMA A156.11, E07041.
- 47 I. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- 48 J. Electronic locks: Provide electronic, keyless lock, keypad, in stainless finish.
- 49 K. Grommets for Cable Passage: **2-inch** OD, molded-plastic grommets and matching plastic caps with slot for wire
50 passage.
 - 51 1. Color: Black.
- 52 L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for
53 ANSI/BHMA finish number indicated.
 - 54 1. Satin Stainless Steel: ANSI/BHMA 630.
- 55 M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in
56 ANSI/BHMA A156.9.

- 1 2.5 MISCELLANEOUS MATERIALS
2 A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent
3 moisture content.
4 B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal
5 expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized
6 anchors and inserts at inside face of exterior walls and at floors.
7 C. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public
8 Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor
9 Sources Using Environmental Chambers."
10 D. Adhesive for Bonding Plastic Laminate: Type II water-resistant type as selected by fabricator to comply with
11 requirements.
12 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

- 13 2.6 FABRICATION
14 A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
15 B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment
16 to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for
17 fitting at site, provide ample allowance for scribing, trimming, and fitting.
18 C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items.
19 Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped
20 openings. Sand edges of cutouts to remove splinters and burrs.

21
22 PART 3 - EXECUTION
23

- 24
25 3.1 PREPARATION
26 A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
27 3.2 INSTALLATION
28 A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be
29 installed.
30 B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
31 C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet
32 installation screws.
33 D. Install cabinets level, plumb, and true in line to a tolerance of **1/8 inch in 96 inches** using concealed shims.
34 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
35 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust
36 hardware to center doors and drawers in openings and to provide unencumbered operation. Complete
37 installation of hardware and accessory items as indicated.
38 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than **16 inches** o.c. with
39 No. 10 wafer-head screws sized for not less than **1-1/2-inch** penetration into wood framing, blocking, or
40 hanging strips.
41 3.3 ADJUSTING AND CLEANING
42 A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not
43 possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
44 B. Clean, lubricate, and adjust hardware.
45 C. Clean cabinets on exposed and semiexposed surfaces.
46

47 **END OF SECTION**

**SECTION 07 01 53
 ROOF MEMBRANE PATCHING AND REPAIR**

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 26 PART 1 – GENERAL
 27
 28 1.1 SUMMARY
 29 A. Section Includes:
 30 1. Patching and repair of existing warrantied EPDM roofing system at new plumbing, mechanical, and
 31 electrical penetrations.
 32 1.2 RELATED WORK
 33 A. Applicable provisions of Division 1 govern work under this Section.
 34 B. Related work specified elsewhere:
 35 1. Section 06 10 53 - Miscellaneous Rough Carpentry
 36 2. Section 07 62 00 – Sheet Metal Flashing and Trim
 37 3. Division 23 for equipment curbs.
 38 1.3 GUARANTEE AND WARRANTIES
 39 A. Contractor shall work with roofing manufacturer to maintain and not void the current warranty of the existing roof:
 40 Firestone Building Products.
 41 B. Roof System Guarantee: Provide written two (2) year guarantee warranting all roofing and flashing required under
 42 contract, to be watertight and free from defects in materials or workmanship for period of time, as stipulated in
 43 guarantee form.
 44 C. It is recommended that the Contractor take digital photos of the finished work for their files and future reference.
 45 1.4 ACTION SUBMITTALS
 46 A. Product Data: Catalog sheets, specifications, installation instructions for each material specified.
 47 B. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.
 48 C. Material Safety Data Sheets (MSDS): Include the MSDS in the Submittals Package.
 49 D. Submit all action items, except contract closeout submittals and MSDS, at one time as a complete package. Partial
 50 submittals will not be considered.
 51 1.5 QUALITY ASSURANCE
 52 A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
 53 B. Fire Hazard Classification: The sheet membrane roof system shall have and Underwriters Laboratories Class A
 54 External Fire Resistance rating, as determined by tests conducted in conformity with UL-790 “Tests for Fire
 55 Resistance of Roof Covering Materials”.
 56 C. Material Classification Identification: Materials delivered to the site that are a component of the roofing system
 57 shall bear the UL Classification mark.

- 1 1.6 QUALIFICATIONS
- 2 A. Contractor/Installer: Installer of roof membrane patching approved by warrantor of existing roofing system to work
- 3 on existing roofing.
- 4 1. Additional Requirement for Field Labor: The supervisor or crew chief and at least one other member of the
- 5 roofing crew shall have installed at least 3 EPDM sheet membrane roof systems and shall be thoroughly
- 6 familiar with all aspects of the installation.
- 7 1.7 DELIVERY, STORAGE, AND HANDLING
- 8 A. Delivery: Deliver materials to the site in the manufacturer's labeled, unbroken containers.
- 9 B. Storage and Handling: Store materials in a dry, well-ventilated place protected from the weather.
- 10 1. Do not store materials so as to overload the deck or structural assembly.
- 11 2. Store all materials on raised platforms covered with properly secured breathable water-resistant covers.
- 12 Slit shrink wrapping to not permit condensation and cover with breathable tarp.
- 13 3. Store volatile liquids in a separate storage building or trailer or removed from the site at the end of each
- 14 workday.
- 15 4. Store volatile liquids at temperatures recommended by the manufacturer.
- 16 5. Do not remove materials from factory packaging until ready for use.
- 17 6. Store adhesives, and sealants at temperatures between 60 degrees F and 80 degrees F.
- 18 1.8 PROJECT CONDITIONS
- 19 A. Owner will occupy portions of building immediately below reroofing area. Conduct reroofing so Owner's operations
- 20 will not be disrupted. Provide Owner with not less than 7 days notice of activities that may affect Owner's
- 21 operations.
- 22 1. Coordinate work activities daily with Owner so Owner can place protective dust or water leakage covers
- 23 over sensitive equipment or furnishings, shut down HVAC and fire-alarm or -detection equipment if needed,
- 24 and evacuate occupants from below the work area.
- 25 2. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below
- 26 the affected area. Verify that occupants below the work area have been evacuated before proceeding with
- 27 work over the impaired deck area.
- 28 B. Protect building to receive roof patching, adjacent buildings, walkways, site improvements, exterior plantings, and
- 29 landscaping from damage or soiling from reroofing operations.
- 30 C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- 31 D. Unless otherwise directed, do not execute the work of this Section if the Owner's/Architects Representative is not
- 32 present.
- 33 E. Do not execute the work of this Section unless the repair area substrate is dry and free of dirt and debris.
- 34 F. Moisture Protection:
- 35 1. Cover, seal or otherwise protect the roof and flashings so that water cannot accumulate or flow under
- 36 completed portions. When and where necessary to accomplish this, provide temporary water cut-offs in
- 37 accordance with the membrane manufacturer's written specifications.
- 38 a. Limit the removal of existing materials to areas that can be completely repaired or temporarily
- 39 protected within the same day. At the discretion of the Owner's Representative, a watertight built-
- 40 up vapor barrier may be acceptable temporary protection for a maximum of 48 hours.
- 41 G. Do not use open flames near volatile materials.
- 42 H. Limit construction loads on roof and for uniformly distributed loads.
- 43 I. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions
- 44 permit Work to proceed without water entering existing roofing system or building.

45

46 PART 2 - PRODUCTS

47

48

- 49 2.1 EPDM SHEET MEMBRANE, SHEET FLASHING, AND RELATED PRODUCTS
- 50 A. The EPDM sheet membrane shall be visually free of streaks, particles of foreign matter, undispersed raw material,
- 51 pinholes, cracks, tears, and shall be uniform in thickness. When unrolled in a relaxed position, the membrane shall
- 52 be free of wrinkles, distortions, and blisters.
- 53 B. EPDM (Ethylene, Propylene, Diene, Monomer) Sheet Membrane:
- 54 1. 60 mil, unreinforced, EPDM membrane.
- 55 C. Sheet Flashing: Membrane manufacturer's cured and uncured EPDM as specified.
- 56 D. Inseam Tape: Membrane manufacturer's minimum 3 inch wide self-adhering tape consisting of cured butyl double
- 57 sided adhesive tape, for inseam splicing of rubber to rubber.

- 1 E. Cured EPDM Cover Tape: Membrane manufacturer's minimum 5 inch wide selfadhering tape consisting of cured
- 2 butyl adhesive laminated to cured EPDM, for installation over EPDM seams, cuts in field membrane, and for
- 3 stripping in metal work.
- 4 F. Uncured EPDM Cover Tape: Membrane manufacturer's minimum 5 inch wide selfadhesive tape, consisting of,
- 5 cured butyl adhesive laminated to uncured EPDM, for installation over base flashing corners, inside and outside
- 6 corners, pipe flashings and other detail work.
- 7 G. Related Products: Membrane manufacturer's bonding adhesive, splicing cement, lap sealant, water cut-off mastic,
- 8 seal, pourable sealer, splice joint cleaning agent and primer, insulation adhesive, and all other products related to
- 9 the sheet membrane system.

10 2.2 INSULATION

- 11 A. Uniform Thickness polyisocyanurate insulation and Tapered polyisocyanurate insulation: Approved closed cell
- 12 polyisocyanurate foam core insulation skinned on both sides with factory applied fiberglass facers suitable for
- 13 installation with hot asphalt and cold adhesive. ASTM C1289-02, Type II, Class 1, Grade 2. UL Classified and Factory
- 14 Mutual Approved for direct application over steel deck. Minimum LTTR: 5.0 per inch thickness. Match existing
- 15 thickness.
- 16 B. Tapered Insulation System: Membrane manufacturer's approved factory tapered polyisocyanurate insulation to
- 17 match existing taper.
- 18 C. Coverboard Insulation: Match existing thickness with membrane manufacturer's approved gypsum roof board.
- 19 D. Tapered Cricket System: Membrane manufacturer's approved 1/2 inch per foot factory tapered polyisocyanurate
- 20 insulation.
- 21 E. Tapered Edge Strips: Membrane manufacturer's approved 1/2 inch per foot factory tapered polyisocyanurate
- 22 insulation.
- 23 F. Deckboard (if required): Match existing thickness with membrane manufacturer's approved gypsum roof board.
- 24 G. Flashing: Comply with Section 07 62 00.
- 25 H. Termination Bar and Fasteners: As recommended by membrane manufacturer.
- 26 I. EPDM Anchor Strips: 6-inch-wide reinforced EPDM.

27 2.3 INSULATION ADHESIVE

- 28 A. Insulation Adhesive: Two-Part, Lowrise polyurethane foam adhesive, or the manufacturer's recommended
- 29 insulation adhesive.

30 2.4 MISCELLANEOUS MATERIALS

- 31 A. Pipe Flashing: Cured premolded EPDM pipe boot.
- 32 B. Mechanical Pipe Supports: Flashing and pre-molded boot with stainless steel draw-band clamp shall be approved
- 33 and supplied by the membrane supplier.
- 34 C. Compression Clamp: Stainless steel or cadmium plated steel worm drive clamp.
- 35 D. Sealant: One-part, low modulus, silicone sealant: Dow Corning's 790, General Electric's Silpruf, Pecora's 864, or
- 36 Tremco's TremPro 646.

37 2.5 MATERIALS FOR VAPOR BARRIER REPAIR

- 38 A. Vapor Barrier: Match existing materials with membrane manufacturer's approved equivalent.

39
40 PART 3 - EXECUTION

41
42
43 3.1 SURFACE PREPARATION

- 44 A. Protect existing membrane roofing system that is indicated not to be reroofed.
- 45 B. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers
- 46 before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the
- 47 ductwork.
- 48 C. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary
- 49 protection in the event of unexpected rain.
- 50 D. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from
- 51 entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose.
- 52 Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
- 53 E. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new
- 54 membrane roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not
- 55 permit water to enter into or under existing membrane roofing system components that are to remain.
- 56 F. Verify that rooftop utilities and service piping have been shut off before beginning the Work.

57 3.2 INSTALLING INFILL INSULATION

- 58 A. Keep insulation absolutely dry at all times. Discard insulation that contains moisture.

- 1 1. Install only as much insulation as can be covered with roofing membrane the same day.
- 2 2. Discard all units with broken corners or similar defects.
- 3 3. At roof drains, terminate the insulation with tapered edge strips so that all flashing and coverstrip joint laps
- 4 can be made within the tapered portion.
- 5 B. Cut back the membrane at affected area to expose the insulation. Remove fasteners holding the insulation, if
- 6 present. Cut the insulation and discard properly, taking care not to damage vapor barrier, if present.
- 7 C. Installing Adhesively Secured Insulation: Set each board in insulation adhesive applied in accordance with
- 8 manufacturer's printed instructions. Press insulation into the adhesive immediately and as necessary thereafter to
- 9 assure proper bonding. Maintain pressure on the adhesive until the adhesive has completely set (20 to 45 minutes).
- 10 D. Installing Insulation Board: Install each layer of insulation with joints staggered. Butt edges and ends snugly so
- 11 there are no gaps between the insulation boards. Discard boards with broken corners and boards that are warped.
- 12 E. Installing Tapered Insulation System: Install the tapered insulation to match the existing tapered insulation system.
- 13 Install each layer of insulation with joints staggered. Butt edges and ends snugly so that there are no gaps between
- 14 the insulation boards.
- 15 F. Install coverboard insulation over the polyisocyanurate insulation.
- 16 3.3 MEMBRANE PREPARATION
- 17 A. Preparing Existing Roof Membrane for patching: Cut the membrane a short distance from and parallel with the
- 18 perimeter, base of the wall, curb or termination point to relieve the tension. Allow the membrane to relax for a
- 19 minimum of 30 minutes.
- 20 3.4 INSTALLING EPDM REPAIR MEMBRANE
- 21 A. Cut a piece of like membrane large enough to extend 4 inches beyond any part of the cut and to provide an
- 22 expansion fold of 4 to 6 inches. Round the corners of the patch to prevent peeling of square corners.
- 23 1. Apply primer to both surfaces to be mated and allow to dry.
- 24 2. If the existing membrane surface is excessively degraded, insert the new patch material under the existing
- 25 membrane so that adhering of the patch may be accomplished to the underside of the existing membrane.
- 26 B. PHASING OF MEMBRANE INSTALLATION
- 27 1. Limit the removal of existing materials and repairs to areas that can be completely repaired within the same
- 28 day.
- 29 3.5 FIELD QUALITY CONTROL
- 30 A. As the repairs are completed or at the end of each workday, in the presence of the Owner's Representative closely
- 31 examine joints in the membrane and repairs. Cut out and repair areas of the joints that are not fully bonded or that
- 32 contain "fishmouths" or "wrinkles". Repair the membrane so it is restored to its full waterproof integrity. Lap
- 33 patches a minimum of 6 inches beyond cuts.
- 34
- 35
- 36

END OF SECTION

**SECTION 07 21 00
THERMAL INSULATION**

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23 PART 1 – GENERAL
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25 1.1 SUMMARY
26 A. Section Includes:
27 1. Polyisocyanurate foam-plastic board insulation.
28 2. Glass-fiber blanket insulation.
29 3. Foamed-in-Place Insulation
30 B. Related Requirements:
31 1. **Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing"**
32 2. **Section 092900 "Gypsum Board"** for sound attenuation blanket used as acoustic insulation.
33 1.2 SUBMITTALS
34 A. Product Data:
35 1. Polyisocyanurate foam-plastic board insulation.
36 2. Glass-fiber blanket insulation.
37 B. Sustainable Design Submittals:
38 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
39 2. Verify insulation complies with the requirements of the California Department of Public Health's "Standard
40 Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using
41 Environmental Chambers."
42 3. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting
43 materials.
44 C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
45 D. Research Reports: For foam-plastic insulation, from ICC-ES.
46 1.3 DELIVERY, STORAGE, AND HANDLING
47 A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other
48 sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing,
49 and protecting during installation.
50 B. Protect foam-plastic board insulation as follows:
51 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
52 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just
53 before installation time.
54 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of
55 construction.
56

- 1 PART 2 - PRODUCTS
2
3
4 2.1 PERFORMANCE REQUIREMENTS
5 A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than **25 and 450** when
6 tested in accordance with ASTM E84.
7 B. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
8 C. Labeling: Provide identification of mark indicating R-value of each piece of insulation **12 inches (305 mm)** and wider
9 in width.
10 2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION
11 A. Polyisocyanurate Board Insulation, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 or 2.
12 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that
13 may be incorporated into the Work include, but are not limited to the following:
14 a. Atlas Polyiso Roof and Wall Insulation.
15 b. Hunter Panels; a Carlisle company.
16 c. Rmax, Inc.
17 B. Thermal-Resistance Value (R-Value): **R-value as indicated below** in accordance with ASTM C518.
18 1. R-Value at 6 per inch.
19 2.3 GLASS-FIBER BLANKET INSULATION
20 A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
21 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that
22 may be incorporated into the Work include, but are not limited to the following:
23 a. CertainTeed; SAINT-GOBAIN.
24 b. Johns Manville; a Berkshire Hathaway company.
25 c. Knauf Insulation.
26 d. Owens Corning.
27 2. Recycled content: 25 percent.
28 3. Formaldehyde free.
29 2.4 SPRAY POLYURETHANE FOAM INSULATION
30 A. Closed-Cell Polyurethane Foam Insulation per ASTM C 1029, Type II.
31 B. Manufacturer's name and products are given to clarify the designer's intent and are not intended to limit selection
32 of similar products from acceptable manufacturers. Qualification data for manufacturers and products not
33 specified shall be made at time of submittal during construction. Preapproval will not be performed by the
34 Government.
35 1. BASF; SPRAYTITE 81206 Series
36 2. Certainteed; CertaSpray
37 3. Johns Manville; JM Corbond III
38 4. Characteristics:
39 a. Core Density: 1.9-2.2 lbs/cu. ft (ASTM D-1622),
40 b. R-Value: 6.5 per inch (ASTM C-518)
41 c. Fire Rating per ASTM E 84: Maximum flame-spread / smoke-developed indexes of 75 and and 450,
42 respectively.
43 d. Moisture Vapor transmission of 0.23 perms at 3 inches (ASTM C-518)
44 e. Air leakage rate of 0.00+/-0.01(L/s)/m^2 (ASTM E-96)
45 f. Fungi Resistance: Zero Rating (ASTM G-21)
46 g. Compressive Strength: 15-20 psi (ASTM D-1622)
47 h. Tensile Strength: 55-65 psi (ASTM D-1623)
48 i. Dimensional Stability: (7 days @ 158F,95%RH) 6% Vol. Change (ASTM D- 2126)
49 2.5 INSULATION FASTENERS
50 A. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-** thick galvanized-steel sheet, with
51 beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than **1-1/2**
52 **inches** square or in diameter.
53 2.6 ACCESSORIES
54 A. Insulation for Miscellaneous Voids:
55 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed
56 indexes of 5, per ASTM E84.
57 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and
58 smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

1 PART 3 - EXECUTION

2 3.1 PREPARATION

3 A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing
4 insulation or vapor retarders, or that interfere with insulation attachment.

5 3.2 INSTALLATION, GENERAL

6 A. Comply with insulation manufacturer's written instructions applicable to products and applications.

7 B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at
8 any time.

9 C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

10 D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation.
11 Remove projections that interfere with placement.

12 E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply
13 single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or
14 to achieve R-value.

15 3.3 INSTALLATION OF CAVITY-WALL INSULATION

16 A. Foam-Plastic Board Insulation: Install fasteners spaced approximately 24 inches o.c. both ways on inside face and as
17 recommended by manufacturer.

18 1. Fit courses of insulation between obstructions, with edges butted tightly in both directions, and with faces
19 flush.

20 2. Press units firmly against inside substrates.

21 3.4 INSTALLATION OF SPRAY POLYURETHANE FOAM INSULATION

22 A. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not
23 apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls are completed and
24 windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is
25 applied, make flush with face of studs by using method recommended by insulation manufacture.

26 3.5 PROTECTION

27 A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

28 B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and
29 protected by permanent construction immediately after installation.

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31

END OF SECTION

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SECTION 07 27 26
FLUID-APPLIED MEMBRANE AIR BARRIER

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25 PART 1 – GENERAL
26
27 1.1 SUMMARY
28 A. Section Includes:
29 1. High-build air barriers, vapor retarding.
30 1.2 DEFINITIONS
31 A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
32 B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including
33 joints and junctions to abutting construction, to control air movement through the wall.
34 C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
35 1.3 PREINSTALLATION MEETINGS
36 1.4 SUBMITTALS
37 A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate;
38 technical data; dry film thickness; and tested physical and performance properties of products.
39 1. High-build air barriers, vapor retarding.
40 B. Shop Drawings: For air-barrier assemblies.
41 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project
42 conditions.
43 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside
44 corners, terminations, and tie-ins with adjoining construction.
45 3. Include details of interfaces with other materials that form part of air barrier.
46 C. Qualification Data: For Installer. **Include list of ABAA-certified installers and supervisors employed by Installer,**
47 **who work on Project.**
48 D. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials
49 with Project materials that connect to or that come in contact with the barrier.
50 E. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
51 1.5 QUALITY ASSURANCE
52 A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by
53 manufacturer.
54 1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ
55 ABAA-certified installers and supervisors on Project.
56 B. Mockups: Build mockups to set quality standards for materials and execution.
57 1. Build integrated mockups of exterior wall assembly, **150 sq. ft.**, incorporating backup wall construction,
58 external cladding, insulation, ties and other penetrations, and flashing to demonstrate surface preparation,

- 1 crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of
2 air-barrier assembly.
- 3 a. Include junction with roofing membrane.
- 4 b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply
5 air barrier until mockups are approved.
- 6 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
7 mockups unless Architect specifically approves such deviations in writing.
- 8 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if
9 undisturbed at time of Substantial Completion.
- 10 1.6 DELIVERY, STORAGE, AND HANDLING
- 11 A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- 12 B. Protect stored materials from direct sunlight.
- 13 1.7 FIELD CONDITIONS
- 14 A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended
15 in writing by air-barrier manufacturer.
- 16 1. Protect substrates from environmental conditions that affect air-barrier performance.
- 17 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.
- 18
- 19 PART 2 - PRODUCTS
- 20
- 21
- 22 2.1 SOURCE LIMITATIONS
- 23 A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.
- 24 2.2 PERFORMANCE REQUIREMENTS
- 25 A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a
26 continuous air barrier **and as a liquid-water drainage plane flashed to discharge to the exterior incidental**
27 **condensation or water penetration**. Air-barrier assemblies to be capable of accommodating substrate movement
28 and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions
29 at perimeter conditions without deterioration and air leakage exceeding specified limits.
- 30 B. Air-Barrier Assembly Air Leakage: Maximum **0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft.**, when tested in
31 accordance with ASTM E2357.
- 32 C. Air Permeance: Maximum **0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft.** pressure difference; ASTM E2178.
- 33 D. Ultimate Elongation: Minimum **200** percent; ASTM D412, Die C.
- 34 E. Adhesion to Substrate: Minimum **16 lbf/sq. in.** when tested in accordance with ASTM D4541.
- 35 F. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- 36 G. UV Resistance: Can be exposed to sunlight for **30** days in accordance with manufacturer's written instructions.
- 37 2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING
- 38 A. High-Build, Vapor-Retarding Air Barrier, Modified Bituminous Type: Modified bituminous membrane with an
39 installed dry film thickness, according to manufacturer's written instructions, of **35 mils** or thicker over smooth,
40 void-free substrates.
- 41 B. High-Build, Vapor-Retarding Air Barrier, Synthetic Polymer Type: Synthetic polymer membrane with an installed dry
42 film thickness, according to manufacturer's written instructions, of **35 mils** or thicker over smooth, void-free
43 substrates.
- 44 C. Vapor Permeance: Maximum **0.05 perm**; ASTM E96/E96M.
- 45 2.4 ACCESSORY MATERIALS
- 46 A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants,
47 counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials,
48 adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by
49 air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-
50 barrier material and adjacent construction to which they may seal.
- 51 B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- 52 C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, **0.0187 inch** thick, and Series 300 stainless steel fasteners.
- 53 D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion,
54 sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for
55 bonding extrusions to substrates.

1 PART 3 - EXECUTION

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3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 - 3. Verify that substrates are visibly dry and free of moisture.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge **joints and** discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.3 INSTALLATION OF ACCESSORIES

- A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install transition strip on roofing membrane or base flashing so that a minimum of **3 inches (75 mm)** of coverage is achieved over each substrate.
 - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply **transition strip or preformed silicone extrusion** so that a minimum of **3 inches** of coverage is achieved over each substrate. Maintain **3 inches** of full contact over firm bearing to perimeter frames, with not less than **1 inch** of full contact.
 - 1. Transition Strip: Roll firmly to enhance adhesion.
 - 2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal top of through-wall flashings to air barrier with an additional **6-inch-** wide, transition strip.
- H. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

- 1 I. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and
2 blisters. Patch with transition strips extending **6 inches** beyond repaired areas in strip direction.
- 3 3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL
- 4 A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in
5 accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within
6 manufacturer's recommended application temperature ranges.
- 7 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate
8 and allow it to dry.
- 9 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for
10 more than 24 hours.
- 11 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between
12 coats.
- 13 B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following
14 thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
- 15 1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness **as recommended in writing by**
16 **manufacturer to comply with performance requirements, but not less than 45 mils**, applied in **one or**
17 **more equal coats**.
- 18 C. Do not cover air barrier until it has been tested and inspected by testing agency.
- 19 D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply
20 air-barrier components.
- 21 3.5 CLEANING AND PROTECTION
- 22 A. Protect air-barrier system from damage during application and remainder of construction period, in accordance
23 with manufacturer's written instructions.
- 24 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by
25 manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier
26 or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed
27 materials in accordance with air-barrier manufacturer's written instructions.
- 28 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier
29 manufacturer.
- 30 B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning
31 agents and procedures recommended in writing by manufacturer of affected construction.
- 32 C. Remove masking materials after installation.
- 33
- 34

END OF SECTION

**SECTION 07 42 13.16
 METAL PLATE WALL PANELS**

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26
 27 PART 1 – GENERAL

- 28
 29 1.1 SUMMARY
 30 A. Section includes metal plate wall panels.
 31 1.2 PREINSTALLATION MEETINGS
 32 A. Preinstallation Conference: Conduct conference at **Project site**.
 33 1. Meet with Owner, Architect, metal panel Installer, metal panel manufacturer's representative, structural-
 34 support Installer, and installers whose work interfaces with or affects metal panels, including installers of
 35 doors, windows, and louvers.
 36 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel,
 37 equipment, and facilities needed to make progress and avoid delays.
 38 3. Review methods and procedures related to metal panel installation, including manufacturer's written
 39 instructions.
 40 4. Examine support conditions for compliance with requirements, including alignment between and
 41 attachment to structural members.
 42 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction
 43 that affect metal panels.
 44 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if
 45 applicable.
 46 7. Review temporary protection requirements for metal panel assembly during and after installation.
 47 8. Review procedures for repair of metal panels damaged after installation.
 48 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to
 49 each participant.
 50 1.3 SUBMITTALS
 51 A. Product Data: For each type of product.
 52 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
 53 finishes for each type of panel and accessory.
 54 B. Sustainable Design Submittals:
 55 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 56 C. Shop Drawings:
 57 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles,
 58 corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

- 1 2. Accessories: Include details of the flashing, trim, and anchorage, at a scale of not less than **1-1/2 inches per**
2 **12 inches (1:10)**.
- 3 D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
4 1. Include similar Samples of trim and accessories involving color selection.
- 5 E. Qualification Data: For Installer.
- 6 F. Product Test Reports: For each product, tests performed by a qualified testing agency.
- 7 G. Sample Warranties: For special warranties.
- 8 H. Maintenance Data: For metal panels to include in maintenance manuals.
- 9 1.4 QUALITY ASSURANCE
- 10 A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by
11 manufacturer.
- 12 B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects
13 and set quality standards for fabrication and installation.
- 14 1. Build mockup of typical metal panel assembly , including supports, attachments, and accessories.
- 15 2. Water-Spray Test: Conduct water-spray test of mockup of metal panel assembly, testing for water
16 penetration according to AAMA 501.2.
- 17 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
18 mockups unless Architect specifically approves such deviations in writing.
- 19 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if
20 undisturbed at time of Substantial Completion.
- 21 1.5 DELIVERY, STORAGE, AND HANDLING
- 22 A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package
23 metal panels for protection during transportation and handling.
- 24 B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- 25 C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering.
26 Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in
27 contact with other materials that might cause staining, denting, or other surface damage.
- 28 D. Retain strippable protective covering on metal panels during installation.
- 29 1.6 FIELD CONDITIONS
- 30 A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit
31 assembly of metal panels to be performed according to manufacturers' written instructions and warranty
32 requirements.
- 33 1.7 COORDINATION
- 34 A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other
35 adjoining work to provide a leakproof, secure, and noncorrosive installation.
- 36 1.8 WARRANTY
- 37 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of
38 metal panel systems that fail in materials or workmanship within specified warranty period.
- 39 1. Failures include, but are not limited to, the following:
40 a. Structural failures including rupturing, cracking, or puncturing.
41 b. Deterioration of metals and other materials beyond normal weathering.
- 42 2. Warranty Period: **Two** years from date of Substantial Completion.
- 43 B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or
44 replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty
45 period.
- 46 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
47 a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
48 b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
49 c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- 50 2. Finish Warranty Period: **20** years from date of Substantial Completion.
- 51 PART 2 - PRODUCTS
- 52 2.1 PERFORMANCE REQUIREMENTS
- 53 A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads,
54 based on testing according to ASTM E330:
- 55 1. Wind Loads: As indicated on Drawings.
- 56 2. Other Design Loads: **As indicated on Drawings.**
- 57 3. Deflection Limits: For wind loads, no greater than **1/240** of the span.

- 1 B. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft.** when tested according to ASTM E283 at the following
2 test-pressure difference:
3 1. Test-Pressure Difference: **1.57 lbf/sq. ft.**
- 4 C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the
5 following test-pressure difference:
6 1. Test-Pressure Difference: **6.24 lbf/sq. ft.**
- 7 D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing
8 buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other
9 detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and
10 nighttime-sky heat loss.
11 1. Temperature Change (Range): **120 deg F, ambient; 180 deg F (100 deg C), material surfaces.**
- 12 2.2 METAL PLATE WALL PANELS
- 13 A. Metal Plate Wall Panels: Provide factory-formed, metal plate wall panels fabricated from single sheets of metal
14 formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners,
15 and accessories required for weathertight system.
16 1. Provide EN-V aluminum wall panel system from Dri-Design or equal product from another manufacture.
17 B. Panel Depth: **1 1/4 inches.**
- 18 C. Aluminum Sheet: Tension-leveled, smooth aluminum sheet, **ASTM B209 (ASTM B209M), 0.080 inch** thick.
19 1. Exterior Finish: **Two-coat fluoropolymer.**
20 a. Color: **As selected by Architect from manufacturer's full range.**
- 21 D. Attachment Assembly: **Subgirt and spline.**
22 1. Subgirt: Pultruded FRP with at least 850 ibf screw pullout resistance in accordance with ASTM D1761.
- 23 2.3 MISCELLANEOUS MATERIALS
- 24 A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet,
25 ASTM A653/A653M, **G90 (Z275 hot-dip galvanized)** coating designation or ASTM A792/A792M, **Class AZ50**
26 **(Class AZM150)** aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's
27 standard sections as required for support and alignment of metal panel system.
- 28 B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings,
29 fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match
30 material and finish of metal panels unless otherwise indicated.
- 31 C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against
32 weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs,
33 corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim
34 with same finish system as adjacent metal panels.
- 35 D. Provide integral drainage system and manufactures standard extrusions at termination of dissimilar materials.
- 36 E. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads
37 matching color of metal panels by means of plastic caps or factory-applied coating. Provide neoprene sealing
38 washers for exposed fasteners.
- 39 F. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use
40 classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by
41 metal panel manufacturer. Provide sealant types that are compatible with panel materials, are nonstaining, and do
42 not damage panel finish.
- 43 2.4 FABRICATION
- 44 A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and
45 processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply
46 with indicated profiles and with dimensional and structural requirements.
- 47 B. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight
48 seal and prevent metal-to-metal contact, and that minimize noise from movements.
- 49 C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and
50 recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and
51 other characteristics of item indicated.
52 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and
53 that are true to line and levels indicated, with exposed edges folded back to form hems.
54 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy
55 seam sealer. Rivet joints for additional strength.
56 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges
57 to be seamed, form seams, and solder.

- 1 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply
- 2 with SMACNA standards.
- 3 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of
- 4 accessories exposed to view.
- 5 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from
- 6 compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
- 7 a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel
- 8 manufacturer for application but not less than thickness of metal being secured.
- 9 2.5 FINISHES
- 10 A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary
- 11 protective covering before shipping.
- 12 B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are
- 13 within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable.
- 14 Variations in appearance of other components are acceptable if they are within the range of approved Samples and
- 15 are assembled or installed to minimize contrast.
- 16 C. Aluminum Panels and Accessories:
- 17 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin
- 18 by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with
- 19 coating and resin manufacturers' written instructions.
- 20 PART 3 - EXECUTION
- 21 3.1 EXAMINATION
- 22 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
- 23 tolerances, metal panel supports, and other conditions affecting performance of the Work.
- 24 1. Examine wall substrate to verify that girts, angles, channels, and other structural panel support members
- 25 and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
- 26 a. Verify that air- or water-resistive barriers have been installed over backing substrate to prevent air
- 27 infiltration or water penetration.
- 28 B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of
- 29 penetrations relative to seam locations of metal panels before installation.
- 30 C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 31 3.2 PREPARATION
- 32 A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and
- 33 anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
- 34 3.3 INSTALLATION
- 35 A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations
- 36 indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other
- 37 components of the Work securely in place, with provisions for thermal and structural movement.
- 38 1. Shim or otherwise plumb substrates receiving metal panels.
- 39 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin
- 40 installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are
- 41 installed.
- 42 3. Install screw fasteners in predrilled holes.
- 43 4. Locate and space fastenings in uniform vertical and horizontal alignment.
- 44 5. Install flashing and trim as metal panel work proceeds.
- 45 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to
- 46 avoid a four-panel lap splice condition.
- 47 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings
- 48 and trim around openings and similar elements with self-tapping screws.
- 49 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- 50 B. Fasteners:
- 51 1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use
- 52 aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- 53 C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic
- 54 action as recommended in writing by metal panel manufacturer.
- 55 D. Attachment Assembly, General: Install attachment assembly required to support metal plate wall panels and to
- 56 provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels,
- 57 panel clips, and anchor channels.

- 1 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-
2 system joint seals.
- 3 E. Subgirt-and-Spline Installation: Install support assembly at locations, spacings, and with fasteners recommended by
4 manufacturer. Use manufacturer's standard subgirts and splines that provide support and complete secondary
5 drainage assembly, draining to the exterior at horizontal joints. Attach metal plate wall panels by interlocking
6 perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt-and-spline gaskets
7 and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.
- 8 1. Install metal plate wall panels to allow individual panels to be installed and removed without disturbing
9 adjacent panels.
- 10 2. Do not apply sealants to joints unless otherwise indicated.
- 11 F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and
12 provide for thermal expansion. Coordinate installation with flashings and other components.
- 13 1. Install components required for a complete metal panel system including trim, copings, corners, seam
14 covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal
15 panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel
16 manufacturer.
- 17 G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and
18 SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to
19 line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
- 20 1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels
21 indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit
22 substrates and to result in waterproof performance.
- 23 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints
24 at a maximum of **10 feet** with no joints allowed within **24 inches** of corner or intersection. Where lapped
25 expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of
26 intermeshing hooked flanges, not less than **1 inch** deep, filled with mastic sealant (concealed within joints).
- 27 3.4 ERECTION TOLERANCES
- 28 A. Installation Tolerances: Shim and align metal plate wall panel units within installed tolerance of **1/4 inch in 20 feet**,
29 non-accumulative, on level, plumb, and location lines as indicated, and within **1/8-inch** offset of adjoining faces and
30 of alignment of matching profiles.
- 31 3.5 CLEANING AND PROTECTION
- 32 A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise
33 indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean
34 finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- 35 B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- 36 C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or
37 similar minor repair procedures.

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END OF SECTION

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**SECTION 07 72 00
ROOF ACCESSORIES**

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17 PART 1 – GENERAL
18
19 1.1 SUMMARY
20 A. Section Includes:
21 1. Installation of the existing roof hatch.
22 B. Related Sections:
23 1. Division 07 Section "Sheet Metal Roofing Specialties" for shop- and field-formed metal flashing, roof-
24 drainage systems, and miscellaneous sheet metal trim and accessories.
25 1.2 PERFORMANCE REQUIREMENTS
26 A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced
27 movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication,
28 installation, or other defects in construction.
29 1.3 COORDINATION
30 A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and
31 adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
32 B. Coordinate dimensions of rough-in information with equipment to be supported.
33
34 PART 2 - PRODUCTS
35
36
37 2.1 MISCELLANEOUS MATERIALS
38 A. General: Provide materials and types of fasteners, sealants, and other miscellaneous items required by
39 manufacturer for a complete installation.
40 B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.
41 C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
42 D. Underlayment:
43 1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
44 2. Polyethylene Sheet: **6-mil-** (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
45 3. Slip Sheet: Building paper, **3-lb/100 sq. ft.** (0.16-kg/sq. m) minimum, rosin sized.
46 E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being
47 fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener
48 heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
49 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-
50 coated steel according to ASTM A 153/A 153M or ASTM F 2329.
51 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
52 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
53 F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of
54 foam rubber, sponge neoprene, or cork.
55 G. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane silicone polymer sealant as recommended by roof
56 accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications
57 required to seal joints and remain watertight.

- 1 H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized;
2 heavy bodied for expansion joints with limited movement.

- 3 I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

4 2.2 ROOF HATCH

- 5 A. Existing to be installed.

6

7 PART 3 - EXECUTION

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9

10 3.1 EXAMINATION

- 11 A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other
12 conditions affecting performance of the Work.

- 13 B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

- 14 C. Verify dimensions of roof openings for roof accessories.

- 15 D. Proceed with installation only after unsatisfactory conditions have been corrected.

16 3.2 INSTALLATION

- 17 A. General: Install roof accessories according to manufacturer's written instructions.

- 18 1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment,
19 excessive oil canning, buckling, or tool marks.

- 20 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.

- 21 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of r
22 roof accessories and fit them to substrates.

- 23 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of
24 fasteners and seals.

- 25 B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each
26 other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent
27 separation as recommended by manufacture

- 28 1. Coat concealed side of uncoated aluminum or stainless-steel roof accessories with bituminous coating
29 where in contact with wood, ferrous metal, or cementitious construction.

- 30 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a
31 course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.

- 32 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for
33 waterproof performance.

- 34 C. Roof-Hatch Installation:

- 35 1. Install roof hatch so top surface of hatch curb is level.

- 36 2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.

- 37 D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

38 3.3 REPAIR AND CLEANING

- 39 A. Clean exposed surfaces according to manufacturer's written instructions.

- 40 B. Clean off excess sealants.

- 41 C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or
42 similar minor repair procedures.

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END OF SECTION

**SECTION 07 84 00
 FIRE STOPPING**

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27
 28 PART 1 – GENERAL
 29
 30 1.1 SUMMARY
 31 A. Section Includes:
 32 1. firestop systems consisting of a material, or combination of materials installed to retain the integrity of fire
 33 rated construction in accordance to the Building Code. The fire stopping systems shall maintain an effective
 34 barrier against the spread of flame, smoke, and/or hot gases through penetrations, blank openings and
 35 construction joints in fire rated construction, or at perimeter fire containment in or adjacent to fire-rated
 36 barriers.
 37 1.2 REFERENCES STANDARDS
 38 A. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.
 39 B. ASTM E 119 Test Method for Fire Tests of Building Construction and Materials.
 40 C. ASTM E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750F.
 41 D. ASTM E 814 Fire Tests of Through-Penetration Fire Stops.
 42 E. ASTM E 1399 Cyclic Movement and Measuring Minimum and Maximum Joint Widths.
 43 F. ASTM E 1966 Test Method for Resistance of Building Joint.
 44 G. ASTM E 2174 Standard Practice for On-Site Inspection of Installed Fire Stops.
 45 H. ASTM E 2393 Standard Practice for On-Site Inspection of Installed Fire Stop Joint Systems.
 46 I. ASTM E 2307 Standard Test Method for Determining the Fire Endurance of Perimeter Fire Barrier Systems Using
 47 the Intermediate-Scale, Multi Story Test Apparatus (ISMA).
 48 J. ASTM G 21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 49 K. NFPA 70 National Electric Code.
 50 L. NFPA 101 Life Safety Code
 51 M. NFPA 221 Standard for High Challenge Firewalls, Firewalls, and Fire Barriers Wall
 52 N. NFPA 251 Tests of Fire Resistance of Building Construction and Materials.
 53 O. UL 263 Fire Tests of Building Construction and Materials.
 54 P. UL 555 Fire Dampers.
 55 Q. UL 723 Surface Burning Characteristics of Building Materials.
 56 R. UL 1479 Fire-Tests of Through-Penetration Fire Stops.
 57 S. UL 2079 Tests for Fire Resistance of Building Joint Systems.
 58 T. International Firestop Council Guideline for Evaluating Firestop System Engineering Judgments.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Fire Rated Construction Requirements: Maintain barrier containment and structural floor fire resistance ratings including resistance to smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and at other fire rated construction gaps. Provide fire stopping systems that resist the spread of fire and the passage of smoke and other gases according to the requirements indicated, including but not limited to the following:

B. Penetrations:

1. Firestop all penetrations passing through fire resistance rated construction.
2. Provide and install complete penetration fire stopping systems that have been tested and approved by a third party testing agency.
3. F - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F Flame spread ratings indicated, as determined per ASTM E 814, but not less than one hour or the fire-resistance rating of the construction being penetrated.
4. T - Rated Through-Penetration Firestop Systems: Provide firestop systems with T Thermal Transmission ratings, in addition to F ratings, as determined per ASTM E 814, where required by code and as otherwise indicated.
5. L – Rated Through-Penetration Firestop Systems: Provide firestop systems with L Air Leakage ratings, in addition to F and T ratings, as determined per UL 1479, where required by code and as otherwise indicated.
6. W – Rated Through-Penetration Firestop Systems: Provide firestop systems with W Water Resistance ratings, in addition to F, T and L ratings, as determined per UL 1479, where indicated.
7. Penetration Fire stopping Assembly: Assemblies are specified generally under UL system categories by penetrating item. Manufacturers' product applications shall have specific UL system designations.

UL Through Penetration Classifications

<u>Fire Stopping System</u>	<u>Construction Penetrated</u>	<u>Type of Construction</u>	<u>System Identification</u>
1 No Penetrating Items	F, W, C	A, B, J, K, L	0001-0999
2 Metallic Pipes, Conduit or Tubing	F, W, C	A, B, J, K, L	1001-1999
3 Nonmetallic Pipe, Conduit or Tubing	F, W, C	A, B, J, K, L	2001-3999
4 Electric Cables	F, W, C	A, B, J, K, L	4001-4999
5 Cable, Trays with Electric Cables:	F, W, C	A, B, J, K, L	5001-5999
6 Insulated Pipes	F, W, C	A, B, J, K, L	6001-6999
7 Electrical Bus duct Penetrations	F, W, C	A, B, J, K, L	7001-7999
8 Mechanical Ductwork Penetrations:	F, W, C	A, B, J, K, L	8001-8999
9 Multiple Penetrations Through Common Openings 9999		F, W, C	A, B, J, K, L 9001-

F = Floor

A = concrete floors 5" or less

W = Wall

B = concrete floors greater than 5"

C = Floor or Wall

J = concrete or masonry walls 8" or less

K = concrete or masonry walls greater than 9"

L = framed wall

C. Joints and Perimeter Systems:

1. Firestop all connections with other surfaces or types of construction, at separations required to permit building movement and at other fire rated or smoke barrier construction gaps.
2. Provide and install complete fire stopping systems that have been tested and approved by a third party testing agency.
3. Provide fire-resistive joint systems with fire and smoke resistance ratings indicated and as determined per ASTM E 1966 or UL 2079, but not less than the fire or smoke resistance rating of the construction in which the joint occurs.
4. Provide perimeter fire barrier systems with fire and smoke resistance ratings indicated and as determined per ASTM E 2307, but not less than the fire or smoke resistance rating of the floor construction.

UL Joint & Curtainwall Classifications

System Type:	Movement Capability	Joint Width
--------------	---------------------	-------------

1	Floor to Floor (FF):	S, D	0000-0999
2	Wall to Wall (WW):	S, D	0000-0999
3	Floor to Wall (FW):	S, D	0000-0999
4	Head of Wall (HW):	S, D	0000-0999
5	Floor to Wall (FW):	S, D	0000-0999
6	Curtain Wall (CW*)	S, D	0000-0999
7		<i>S = Static</i>	<i>0000-0999 = less than or equal to 2"</i>
8		<i>D = Dynamic</i>	<i>1000-1999 = greater than 2", less than or equal to 6"</i>
9			<i>2000-2999 = greater than 6", less than or equal to 12"</i>
10			<i>3000-3999 = greater than 12", less than or equal to 24"</i>
11			<i>4000-4999 = greater than 24"</i>

Note: If **Intertek Curtain Wall** Classification system is used, nomenclature will be **CEJ** or **HI/BP**

5. Provide products that upon curing do not re-emulsify, dissolve, break down or deteriorate from exposure to atmospheric moisture or moisture characteristic to construction.

1.4 SUBMITTALS

1. The following information shall be included on all submitted documents:
2. Submit Manufacturers Product Data Sheets and material safety data sheets (MSDS) for each type of product selected.
3. Where there is no specific third party tested and listed, classified firestop system available for a particular firestop configuration, the contractor shall obtain from the firestop manufacturer, an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRA) for submittal following the "Recommended International Firestop Council Guidelines for Evaluating Firestop Systems in Engineering Judgments".
4. Submit the following:
 - a. Firestopping schedule. Listing agency approved installation detail for each type of penetration treatment with drawing reference of where each is used (type of penetration).
 - b. Certification that Firestop Material is asbestos free and complies with local regulations.
 - c. Certification by fire stopping manufacturer that products supplied comply with specified requirements for volatile organic compounds (VOC's) and are nontoxic to building occupants.
 - d. Contractor qualifications as noted in "Quality Assurance" article, including certification of manufacturer's training.
 - e. Product Data for Credit IEQ.4.1: For fire stopping sealants and sealant primers, documentation including printed statement of VOC content.

1.5 QUALITY ASSURANCE

- A. Provide Fire-resistive System Listing by a testing and inspection agency in accordance with the appropriate ASTM Standard(s) listed. A qualified testing and inspection agency may be UL, FM Research, Intertek Testing Services, Omega Point Laboratories (OPL) or another agency performing testing and follow-up inspection services for fire-resistive system materials that is acceptable to the authority having jurisdiction.
- B. Contractor Qualifications: Acceptable installer firms shall be:
 1. A firm experienced in installing fire stopping systems similar in material, design, and scope to that indicated for this Project, and who has a record of completing past projects. Qualifications include having three years of fire stopping installation experience, staff, and training to install manufacturer's products per specified requirements. Provide statement from manufacturer certifying contractor's staff has successfully completed manufacturer's training on installation requirements of fire stopping systems that will be used on this Project.
- C. Single Source Responsibility:
 1. Materials made by different manufacturers shall not be intermixed in the same opening.
 2. Tested and listed, classified fire-resistive systems are to be used.
 3. If another manufacturer has a tested and listed system, then that system shall be considered before an Equivalent Fire Resistance Rated Assembly (EFRA) is considered.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fire stopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer.
- B. Store and handle fire-resistive materials in accordance with manufacturer's written instructions.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Install fire-resistive system in accordance with manufacturer's written instructions.
- B. Ventilation: Ventilate per manufacturers' instructions or Material Safety Data Sheet (MSDS).

- 1 1.8 PREINSTALLATION COORDINATION
2 A. A firestopping specific preinstallation coordination meeting shall be conducted prior to installing any construction
3 affected by or penetrated by firestopping. This meeting shall include the General Prime Contractor and all
4 contractors installing firestopping, as well as DFD. Each type of firestopping shall be discussed, identifying the
5 penetrating component, the building component or system being penetrated, the firestopping system to be utilized
6 and the contractor responsible to install the firestopping. All firestopping submittals should be consistent with the
7 conclusions of this meeting.
8

9 PART 2 - PRODUCTS
10

- 11
12 A. Where specific manufacturers are named, products by other manufacturers may be considered equal in accordance
13 with the provisions of Article 17 of the General Conditions.

14 2.2 MANUFACTURERS

- 15 A. Systems listed by approved testing agencies may be used providing they conform to the construction type,
16 penetrant type, annular space requirements, and fire rating required for each separate instance.
17 B. Manufacturers of fire stopping shall have been successfully producing and supplying these products for a period of
18 not less than 3 years, and shall be able to show evidence of at least 10 projects where similar products have been
19 installed and accepted.
20 C. Subject to compliance with requirements, provide products by one of the following manufacturers:
21 1. 3M Fire Protection Products.
22 2. HILTI, Inc.
23 3. ProSet Systems, Inc.
24 4. Specified Technologies, Inc.
25 5. Tremco Construction Division.

26 2.3 PENETRATION FIRE STOPPING

- 27 A. Penetrations in Fire-Resistance-Rated Walls: Provide penetration fire stopping with the following ratings
28 determined per ASTM E 814 or UL 1479:
29 1. Fire-resistance-rated walls include fire walls and fire-barrier walls.
30 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
31 B. Penetrations in Horizontal Assemblies: Provide penetration fire stopping with the following ratings determined per
32 ASTM E 814 or UL 1479
33 1. Horizontal assemblies include floor assemblies, floor/ceiling assemblies, roof/ceiling assemblies and roof
34 assemblies.
35 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
36 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for
37 floor penetrations within the cavity of a wall or shaft enclosure above the floor or below the floor.
38 C. Penetrations with Insulated Piping or Ductwork:
39 1. Provide penetration fire stop systems designed for continuous insulation except when penetrating piping is
40 constructed of plastic which shall penetrate fire stop without insulation.
41 D. Penetrations in Floors with Annular Spaces Exceeding 4" and Exposed to Loading and Traffic:
42 1. Provide approved means of supporting floor loads and protecting firestop systems.
43 E. Penetrations for Telecom Equipment Rooms or Where Cable Tray is Discontinuous:
44 1. Provide a manufactured re-enterable system that features a built-in fire and smoke sealing system that
45 allows cables to be added or removed without the need to remove or reinstall fire stopping materials.
46 Examples of such systems are the STI EZ Path and HILTI Speed Sleeve.
47 F. Penetrations for All Other Communication Cabling Applications 2" Diameter and Larger:
48 1. Provide a system that utilizes removable and reusable fire stop material. Examples of such systems are the
49 3M Pass-Through Device, STI FP fire stop plug and HILTI CFS-PL fire stop plug.
50 G. Penetrations Designed for Future Penetrants:
51 1. Provide removable non-sealant fire stop for spare penetrations.
52 H. Flame Spread and Smoke Developed Ratings:
53 1. Provide products with flame-spread and smoke-developed indexes of 25 and 450 or less, respectively, or 25
54 and 50 or less in air plenums, as determined per ASTM E 84.
55 I. VOC Content: Penetration fire stopping sealants and sealant primers shall comply with the following limits for VOC
56 content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
57 1. Sealants: 250 g/L.
58 2. Sealant Primers for Nonporous Substrates: 250 g/L.

- 1 3. Sealant Primers for Porous Substrates: 775 g/L.
- 2 J. Accessories:
- 3 1. Provide components for each penetration fire stopping system that are needed to install fill materials and
- 4 to maintain ratings required. Use only those components specified by penetration fire stopping
- 5 manufacturer and approved by qualified testing and inspecting agency for fire stopping indicated.
- 6 2.4 FIRE-RESISTIVE JOINT FIRE STOPPING
- 7 A. Where required, provide fire-resistive joint fire stopping that is produced and installed to resist spread of fire
- 8 according to code and requirements indicated, resist passage of smoke and other gases, and maintain original fire-
- 9 resistance rating of assemblies in or between which fire-resistive joint stopping is installed. Fire-resistive joint fire
- 10 stopping shall accommodate building movements without impairing its ability to resist the passage of fire and hot
- 11 gases.
- 12 B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with the following
- 13 ratings determined per ASTM E 1966 or UL 2079:
- 14 1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies, and
- 15 roofs or roof/ceiling assemblies.
- 16 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
- 17 C. Flame Spread and Smoke Developed Ratings:
- 18 1. Provide products with flame-spread and smoke-developed indexes of 25 and 450 or less, respectively, or 25
- 19 and 50 or less in air plenums, as determined per ASTM E 84.
- 20 D. VOC Content: Fire-resistive joint system and perimeter fire barrier sealants shall comply with the following limits for
- 21 VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- 22 1. Architectural Sealants: 250 g/L.
- 23 2. Sealant Primers for Nonporous Substrates: 250 g/L.
- 24 3. Sealant Primers for Porous Substrates: 775 g/L.
- 25 E. Accessories:
- 26 1. Provide components of fire-resistive joint systems and perimeter fire barrier systems, including primers and
- 27 forming materials, which are needed to install fill materials and to maintain ratings required. Use only
- 28 components specified by fire-resistive joint system manufacturer and approved by the qualified testing
- 29 agency for systems indicated.
- 30

31 PART 3 - EXECUTION

32

33

34 3.1 APPLICATION

- 35 A. Fire stopping systems shall be used in applications approved by the manufacturer and in locations including, but not
- 36 limited to, the following where required by code and as otherwise indicated:
- 37 1. Penetrations through fire-resistance-rated floor assemblies, floor/ceiling assemblies, roof/ceiling assemblies
- 38 and roof assemblies requiring protected openings including both empty openings and openings that contain
- 39 penetrations.
- 40 2. Penetrations through fire-resistance-rated wall assemblies including both empty openings and openings
- 41 that contain penetrations.
- 42 3. Membrane penetrations in fire-resistance-rated wall assemblies where items penetrate one side of the
- 43 barrier.
- 44 4. Joints in fire-resistance-rated assemblies to allow independent movement.
- 45 5. Perimeter joints between fire-resistance-rated floor assemblies, floor/ceiling assemblies, roof/ceiling
- 46 assemblies or roofs and exterior wall assemblies.

47 3.2 EXAMINATION

- 48 A. Examine substrates and conditions, with installer present, for compliance with requirements for opening
- 49 configurations, penetrating items, substrates, and other conditions affecting performance of fire-resistive system.
- 50 Notify the Project Representative of any unsatisfactory conditions. Do not proceed with installation until
- 51 unsatisfactory conditions have been corrected.

52 3.3 PREPARATION

- 53 A. Cleaning and Preparation: Clean and prepare surfaces as recommended by system manufacturer.
- 54 B. Verify system components are clean, dry, and ready for installation.
- 55 C. Verify field dimensions are as shown on the Drawings, are as tested and listed for classified systems, and meet
- 56 manufacturer requirements and recommendations.

- 1 3.4 PENETRATION FIRE STOPPING
- 2 A. Comply with the "System Performance Requirements" listed in Part 1 and with the manufacturer's installation
- 3 instructions and drawings pertaining to products and applications indicated. Protect fire stopping systems, including
- 4 those raised 2" above surrounding floor, from damage due to construction activities.
- 5 3.5 FIRE-RESISTIVE JOINT FIRE STOPPING
- 6 A. Comply with the "System Performance Requirements" listed in Part 1 and with the manufacturer's installation
- 7 instructions and drawings pertaining to products and applications indicated.
- 8 B. Install tested and listed classified systems that result in fire-resistive joint and perimeter fire barrier materials:
- 9 1. Directly contacting and fully wetting joint substrates.
- 10 2. Completely filling recesses provided for each joint configuration,
- 11 3. Providing uniform, cross-sectional shapes and depths relative to joint width that optimize movement
- 12 capability and meet tested and listed system requirements.
- 13 C. Tool non-sag materials immediately after their application and prior to the time skinning begins. Form smooth,
- 14 uniform beads of configuration indicated or required to:
- 15 1. Produce fire-resistance rating
- 16 2. To eliminate air pockets
- 17 3. To ensure contact and adhesion with sides of joint.
- 18 3.6 FIELD QUALITY CONTROL
- 19 A. Inspection: Independent inspection agency may be employed and paid by Owner to examine and photograph fire
- 20 stopping.
- 21 B. Where deficiencies are found or fire stopping systems are damaged or removed because of testing, repair or
- 22 replace fire stopping to comply with requirements.
- 23 C. Proceed with enclosing fire stopping with other construction only after inspection reports are issued and
- 24 installations comply with requirements.
- 25 3.7 IDENTIFICATION
- 26 A. Identify fire stopping with preprinted labels. Attach labels permanently to surfaces adjacent to and within 6 inches
- 27 (152 mm) of fire stopping edge so labels will be visible to anyone seeking to remove penetrating items or fire
- 28 stopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding
- 29 labels to surfaces on which labels are placed. Include the following information on labels:
- 30 1. "FIRESTOPPED PENETRATION"
- 31 2. Installed Product
- 32 3. UL System Number
- 33 4. Date of Installation
- 34 5. Installing Contractor and Phone Number
- 35 B. Fire walls, fire barriers, fire partitions or any other wall required to have protected openings or penetrations shall
- 36 be effectively and permanently identified with signs or stenciling which include the hourly rating. Such identification
- 37 shall:
- 38 1. Be located in accessible concealed floor, floor-ceiling or attic spaces;
- 39 2. Be located within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured
- 40 horizontally along the wall or partition.
- 41 3. Include lettering not less than 3 inches in height with a minimum 3/8 inch stroke in a contrasting color
- 42 incorporating the wording.
- 43 4. "FIRE AND/OR SMOKE BARRIER—PROTECT ALL OPENINGS, _ HOURLY RATING"
- 44 3.8 CLEANING
- 45 A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses. Use methods and
- 46 cleaning materials approved by manufacturers of fire stopping products and or assemblies in which openings and
- 47 joints occur.
- 48
- 49

END OF SECTION

**SECTION 07 92 00
 JOINT SEALANTS**

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 24

25 PART 1 – GENERAL
 26
 27 1.1 SUMMARY
 28 A. Section Includes:
 29 1. Mildew-Resistant Silicone joint sealants.
 30 2. Latex joint sealants.
 31 3. Silicone joint sealants.
 32 4. Urethane joint sealants.
 33 5. Acoustical joint sealants.
 34 1.2 SUBMITTALS
 35 A. Product Data: For each joint-sealant product indicated.
 36 B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full
 37 range of colors available for each product exposed to view.
 38 1. Provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long Strips of
 39 material matching the appearance of exposed surfaces adjacent to joint sealants.
 40 C. Joint-Sealant Schedule: Include the following information:
 41 1. Joint-sealant application, joint location, and designation.
 42 2. Joint-sealant manufacturer and product name.
 43 3. Joint-sealant formulation.
 44 4. Joint-sealant color.
 45 D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
 46 E. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be
 47 validated by SWRI's Sealant Validation Program.
 48 F. Warranties: Sample of special warranties.
 49 1.3 QUALITY ASSURANCE
 50 A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of
 51 units required for this Project.
 52 B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
 53 C. Product Testing: Test joint sealants using a qualified testing agency.
 54 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to
 55 conduct the testing indicated.
 56 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by
 57 reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and
 58 indentation hardness.

- 1 D. Provisions should be made to afford the construction representative actual close up inspection of all sealant and
- 2 related work.
- 3 1.4 PROJECT CONDITIONS
- 4 A. Do not proceed with installation of joint sealants under the following conditions:
- 5 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant
- 6 manufacturer or are below 40 deg F.
- 7 2. When joint substrates are wet.
- 8 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
- 9 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

10
11 PART 2 - PRODUCTS

12
13
14 2.1 MATERIALS, GENERAL

- 15 A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another
- 16 and with joint substrates under conditions of service and application, as demonstrated by joint-sealant
- 17 manufacturer, based on testing and field experience.
- 18 B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system
- 19 that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D
- 20 (EPA Method 24):
- 21 1. Architectural Sealants: 250 g/L.
- 22 2. Sealant Primers for Nonporous Substrates: 250 g/L.
- 23 3. Sealant Primers for Porous Substrates: 775 g/L.
- 24 C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied
- 25 joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related
- 26 to exposure and joint substrates.
- 27 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be
- 28 continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247.
- 29 Liquid used for testing sealants is deionized water, unless otherwise indicated.
- 30 D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide
- 31 products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates
- 32 indicated for Project.
- 33 E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with
- 34 food, provide products that comply with 21 CFR 177.2600.
- 35 F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

36 2.2 MILDEW-RESISTANT SILICONE JOINT SEALANTS

- 37 A. Mildew-Resistant, Single-Component, Nonsag, plus 25 percent and minus 25 percent movement capability,
- 38 Nontraffic-use, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
- 39 B. Products: Subject to compliance with requirements, provide one of the following:
- 40 1. Dow Corning Corporation; 786 Mildew Resistant.
- 41 2. GE Advanced Materials - Silicones; Sanitary SCS1700.
- 42 3. Tremco Incorporated; Tremsil 200 Sanitary.

43 2.3 URETHANE JOINT SEALANTS

- 44 A. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920. Type S, Grade NS, Class 25, for
- 45 Use T.
- 46 B. Products: Subject to compliance with requirements, provide one of the following:
- 47 1. Pacific Polymers International, Inc.; Elasto-Thane 230 Type II.
- 48 2. Sika Corporation, Construction Products Division; Sikaflex - 1a.
- 49 3. Tremco Incorporated; Vulkem 116.

50 2.4 SILICONE JOINT SEALANTS

- 51 A. Single-Component, Nonsag, Neutral-Curing Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
- 52 1. Products: Subject to compliance with requirements, provide one of the following:
- 53 a. Dow Corning Corporation; 799.
- 54 b. Polymeric Systems, Inc., PSI-631
- 55 c. Pecora Corp., 898
- 56 d. Tremco Incorporated; Tremsil 600.

57 2.5 LATEX JOINT SEALANTS

- 58 A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

- 1 B. Products: Subject to compliance with requirements, provide one of the following:
2 1. BASF Building Systems; Sonolac.
3 2. Pecora Corporation; AC-20+.
4 3. Tremco Incorporated; Tremflex 834.
- 5 2.6 ACOUSTICAL JOINT SEALANTS
- 6 A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with
7 ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in
8 building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- 9 B. Products: Subject to compliance with requirements, provide one of the following:
10 1. Pecora Corporation; AC-20 FTR.
11 2. USG Corporation; SHEETROCK Acoustical Sealant.
- 12 2.7 JOINT SEALANT BACKING
- 13 A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants,
14 primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field
15 experience and laboratory testing.
- 16 B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or Type B (bicellular
17 material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing
18 optimum sealant performance.
- 19 C. Joint subcaulking material should be sized to be under approximately 25% or less compression when in final
20 position, except for joint configurations requiring 1/2 round or 1/4 round rod stock, which should be secured in
21 position with a nonsmear adhesive.
- 22 D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing
23 sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide non-
24 smearing, self-adhesive tape where applicable.
- 25 2.8 MISCELLANEOUS MATERIALS
- 26 A. Primer: Unpigmented and durable, made by manufacture of joint-sealant used and should be specifically designed
27 as a prime coating for material(s) on which the compound will be applied.
- 28 B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing
29 materials, free of residues or other substances capable of staining, etching, marring or harming joint substrates and
30 adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint
31 substrates.
- 32 C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints
33
- 34 PART 3 - EXECUTION
- 35
- 36
- 37 3.1 EXAMINATION
- 38 A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint
39 configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- 40 B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 41 3.2 PREPARATION
- 42 A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant
43 manufacturer's written instructions and the following requirements:
- 44 B. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust,
45 paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by
46 sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- 47 C. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these
48 methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove
49 loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free
50 compressed air. Porous joint substrates include the following:
51 1. Concrete.
52 2. Masonry.
53 3. Unglazed surfaces of ceramic tile.
- 54 D. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates,
55 or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the
56 following:
57 1. Metal.
58 2. Glass

- 1 3. Porcelain enamel.
- 2 4. Glazed surfaces of ceramic tile.
- 3 E. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by
- 4 preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant
- 5 manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or
- 6 migration onto adjoining surfaces. All porous materials should be primed as part of joint preparation, and
- 7 nonporous materials treated as recommended by the sealant manufacturer.
- 8 F. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces
- 9 that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to
- 10 remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
- 11 3.3 INSTALLATION OF JOINT SEALANTS
- 12 A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications
- 13 indicated, unless more stringent requirements apply.
- 14 B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable
- 15 to materials, applications, and conditions indicated.
- 16 C. Depth of sealant at the center of its cross section should be uniform and approximately 1/2 width of sealant, with
- 17 no depth less than 1/3 the width. Depth of sealant at bond interface should be uniform and approximately equal to
- 18 width of sealant with no depth less than 3/4 the width, except where a bond breaker is used.
- 19 D. Whenever a caulked joint is required between two surfaces which are at approximately 90° to each other, sealant
- 20 should be provided with proper backing to obtain the reduced depth of the sealant required at the center of its
- 21 cross section.
- 22 E. Joints in general should be 3/8" wide unless indicated otherwise on the drawings, with no joint less than 1/4" wide.
- 23 F. Install sealant backings of kind indicated to support sealants during application and at position required to produce
- 24 cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant
- 25 movement capability.
- 26 1. Do not leave gaps between ends of sealant backings
- 27 2. Do not stretch, twist, puncture, or tear sealant backings.
- 28 3. Remove absorbent sealant backings that have become wet before sealant application and replace them
- 29 with dry materials.
- 30 G. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of
- 31 joints.
- 32 H. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
- 33 1. Place sealants so they directly contact and fully wet joint substrates.
- 34 2. Completely fill recesses in each joint configuration.
- 35 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant
- 36 movement capability.
- 37 I. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool
- 38 sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of
- 39 configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- 40 1. Remove excess sealant from surfaces adjacent to joints.
- 41 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or
- 42 adjacent surfaces.
- 43 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- 44 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
- 45 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in
- 46 ASTM C 1193.
- 47 a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- 48 J. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at
- 49 perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant.
- 50 Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with
- 51 ASTM C 919 and with manufacturer's written recommendations.
- 52 3.4 CLEANING
- 53 A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning
- 54 materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- 55 3.5 PROTECTION
- 56 A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage
- 57 resulting from construction operations or other causes so sealants are without deterioration or damage at time of
- 58 Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged

1 or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original
2 work.
3
4

1 JOINT-SEALANT SCHEDULE

2 Provide the following sealant types to the joint conditions described below including, but not limited to the following:

3

4 Joint-Sealant Application: Interior and exterior joints in horizontal traffic surfaces.

5 Joint Locations:

6 Isolation joints in cast-in-place concrete slabs.

7 Other porous joints as indicated.

8

9 Urethane Joint Sealant: Single component, nonsag, traffic grade.

10 Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

11

12 Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

13 Joint Locations:

14 Control and expansion joints on exposed interior surfaces of exterior walls.

15 Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.

16 Perimeter joints between interior wall surfaces and frames of interior doors, and windows.

17 Other joints as indicated.

18

19 Joint Sealant: Silicone.

20 Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

21

22 Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

23 Joint Locations:

24 Joints between plumbing fixtures and adjoining walls, floors, and counters.

25 Tile control and expansion joints.

26 Other joints as indicated.

27

28 Joint Sealant: Silicone, single component, nonsag, mildew resistant, acid curing.

29 Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

30

31 Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

32 Joint Location:

33 Acoustical joints where indicated.

34 Other joints as indicated.

35

36 Joint Sealant: Acoustical.

37 Joint-Sealant Color: As selected by Architect from manufacturer's full range.

38

39 General Notes: For conditions not scheduled, provide manufacturer's recommendations.

40

41

END OF SECTION

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

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28

29 PART 1 – GENERAL
30
31 1.1 SUMMARY
32 A. Section Includes:
33 1. Interior standard steel doors and frames.
34 2. Exterior standard steel doors and frames.
35 B. Related Requirements:
36 1. **Section 087100 "Door Hardware"** for door hardware for hollow-metal doors.
37 1.2 DEFINITIONS
38 A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or
39 ANSI/SDI A250.8.
40 1.3 COORDINATION
41 A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for
42 installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such
43 items to Project site in time for installation.
44 B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and
45 security systems.
46 1.4 SUBMITTALS
47 A. Product Data:
48 1. Interior standard steel doors and frames.
49 2. Exterior standard steel doors and frames.
50 B. Product Data Submittals: For each product.
51 1. Include construction details, material descriptions, core descriptions, **fire-resistance ratings** and finishes.
52 C. Sustainable Design Submittals:
53 1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled
54 content not less than **25** percent.
55 2. Environmental Product Declaration: For each product.
56 3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
57 D. Shop Drawings: Include the following:
58 1. Elevations of each door type.

- 1 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
- 2 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- 3 4. Locations of reinforcement and preparations for hardware.
- 4 5. Details of each different wall opening condition.
- 5 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security
- 6 systems.
- 7 7. Details of anchorages, joints, field splices, and connections.
- 8 8. Details of accessories.
- 9 9. Details of moldings, removable stops, and glazing.
- 10 E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same
- 11 reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.
- 12 F. Qualification Data: For door inspector.
- 13 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
- 14 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
- 15 G. Product Test Reports: For each type of **fire-rated hollow-metal door and frame assembly and thermally rated door**
- 16 **assemblies** for tests performed by a qualified testing agency indicating compliance with performance requirements.
- 17 H. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door
- 18 accesses.
- 19 1.5 QUALITY ASSURANCE
- 20 A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies
- 21 is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
- 22 B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to
- 23 meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
- 24 1.6 DELIVERY, STORAGE, AND HANDLING
- 25 A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and
- 26 Project-site storage. Do not use nonvented plastic.
- 27 1. Provide additional protection to prevent damage to factory-finished units.
- 28 B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and
- 29 mullions.
- 30 C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum **4-inch-**
- 31 **(102-mm-)** high wood blocking. Provide minimum **1/4-inch (6-mm)** space between each stacked door to permit air
- 32 circulation.
- 33
- 34 PART 2 - PRODUCTS
- 35
- 36
- 37 2.1 HOLLOW METAL DOORS AND FRAMES
- 38 A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be
- 39 incorporated into the Work include, but are not limited to the following:
- 40 1. Ceco Door; AADG, Inc.; ASSA ABLOY.
- 41 2. Curries, AADG, Inc.; ASSA ABLOY Group.
- 42 3. Steelcraft; Allegion plc.
- 43 2.2 PERFORMANCE REQUIREMENTS
- 44 A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing
- 45 agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on
- 46 testing at positive pressure in accordance with NFPA 252 or UL 10C.
- 47 B. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than **0.40 deg Btu/F x h x sq.**
- 48 **ft.** when tested in accordance with ASTM C1363 or ASTM E1423.
- 49 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES
- 50 A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware
- 51 locations, hardware reinforcement, tolerances, and clearances, and as specified.
- 52 B. Maximum-Duty Doors and Frames: ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A.
- 53 1. Doors:
- 54 a. Type: As indicated in the Door and Frame Schedule on Drawings.
- 55 b. Thickness: **1-3/4 inches.**
- 56 c. Face: **Uncoated** steel sheet, minimum thickness of **0.067 inch.**
- 57 d. Edge Construction: **Model 1, Full Flush.**
- 58 e. Edge Bevel: **Provide manufacturer's standard beveled or square edges.**

- 1 f. Core: **Manufacturer's standard**.
- 2 g. Fire-Rated Core: Manufacturer's standard **vertical steel stiffener or laminated mineral board** core
- 3 for fire-rated doors.
- 4 2. Frames:
- 5 a. Materials: **Uncoated** steel sheet, minimum thickness of **0.067 inch**.
- 6 b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
- 7 c. Construction: **Full profile welded**.
- 8 3. Exposed Finish: **Prime**.
- 9 2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES
- 10 A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware
- 11 locations, hardware reinforcement, tolerances, and clearances, and as specified.
- 12 B. Maximum-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A.
- 13 1. Doors:
- 14 a. Type: As indicated in the Door and Frame Schedule on Drawings.
- 15 b. Thickness: **1-3/4 inches (44.5 mm)**.
- 16 c. Face: Metallic-coated steel sheet, minimum thickness of **0.067 inch**, with minimum **A60 (ZF180)**
- 17 coating.
- 18 d. Edge Construction: **Model 2, Seamless**.
- 19 e. Edge Bevel: **Provide manufacturer's standard beveled or square edges**.
- 20 f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
- 21 Seal joints against water penetration.
- 22 g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face
- 23 sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
- 24 h. Core: **Polyisocyanurate**.
- 25 i. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical
- 26 stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not
- 27 more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c.
- 28 Fill spaces between stiffeners with glass- or mineral-fiber insulation.
- 29 2. Frames:
- 30 a. Materials: Metallic-coated steel sheet, minimum thickness of **0.067 inch**, with minimum **A60**
- 31 coating.
- 32 b. Construction: **Full profile welded**.
- 33 3. Exposed Finish: **Prime**.
- 34 2.5 BORROWED LITES
- 35 A. Fabricate of **uncoated** steel sheet, minimum thickness of **0.053 inch**.
- 36 B. Construction: **Full profile welded**.
- 37 C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are
- 38 fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint,
- 39 fabricated of metal of same or greater thickness as metal as frames.
- 40 D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
- 41 2.6 HOLLOW-METAL PANELS
- 42 A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.
- 43 2.7 FRAME ANCHORS
- 44 A. Jamb Anchors:
- 45 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for
- 46 performance level indicated.
- 47 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor.
- 48 Provide one additional anchor for each **24 inches (610 mm)** of frame height above **7 feet (2.1 m)**.
- 49 3. Postinstalled Expansion Anchor: Minimum **3/8-inch- (9.5-mm-)** diameter bolts with expansion shields or
- 50 inserts, with manufacturer's standard pipe spacer.
- 51 B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- 52 C. Material: ASTM A879/A879M, Commercial Steel (CS), **04Z (12G)** coating designation; mill phosphatized.
- 53 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or
- 54 ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.
- 55 2.8 MATERIALS
- 56 A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- 57 B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface
- 58 defects; pickled and oiled.

- 1 C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
2 D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
3 E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from
4 corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type
5 indicated.
6 F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured
7 from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively;
8 passing ASTM E136 for combustion characteristics.
9 G. Glazing: Comply with requirements in Section 088000 "Glazing."
10 2.9 FABRICATION
11 A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple
12 sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of
13 metal of same or greater thickness as frames.
14 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints,
15 fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
16 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise
17 indicated.
18 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep
19 holes clear during construction.
20 a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
21 b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
22 B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware,
23 and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with
24 ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
25 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
26 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
27 C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings
28 with **mitered** hairline joints.
29 1. Provide stops and moldings flush with face of door, and with **square** stops unless otherwise indicated.
30 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of
31 being removed independently.
32 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide
33 loose stops and moldings on inside of hollow-metal doors and frames.
34 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
35 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not
36 more than **9 inches** o.c. and not more than **2 inches** o.c. from each corner.
37 D. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear
38 during construction.
39 1. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
40 E. STEEL FINISHES
41 F. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
42 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with
43 ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and
44 field-applied coatings despite prolonged exposure.
45 2.10 LOUVERS
46 A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of
47 **0.020-inch**-thick, cold-rolled steel sheet set into **0.032-inch**-thick steel frame.
48 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
49 B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure
50 side of interior doors and frames.
51
52 PART 3 - EXECUTION
53
54
55 3.1 PREPARATION
56 A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing,
57 as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes
58 where spreaders are removed.

- 1 B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2 3.2 INSTALLATION
3 A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with
4 approved Shop Drawings and with manufacturer's written instructions.
5 B. Hollow-Metal Frames: Comply with **ANSI/SDI A250.11**
6 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set.
7 After wall construction is complete, remove temporary braces without damage to completed Work.
8 a. Where frames are fabricated in sections, field splice at approved locations by welding face joint
9 continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-
10 up finishes.
11 b. Install frames with removable stops located on secure side of opening.
12 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
13 3. Floor Anchors: Secure with postinstalled expansion anchors.
14 4. Solidly pack mineral-fiber insulation inside frames.
15 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and
16 masonry with grout or mortar.
17 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion
18 anchors. **Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.**
19 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
20 a. Squareness: Plus or minus **1/16 inch**, measured at door rabbet on a line 90 degrees from jamb
21 perpendicular to frame head.
22 b. Alignment: Plus or minus **1/16 inch**, measured at jambs on a horizontal line parallel to plane of wall.
23 c. Twist: Plus or minus **1/16 inch**, measured at opposite face corners of jambs on parallel lines, and
24 perpendicular to plane of wall.
25 d. Plumbness: Plus or minus **1/16 inch**, measured at jambs at floor.
26 C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
27 1. Non-Fire-Rated Steel Doors: Comply with **ANSI/SDI A250.8**.
28 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
29 D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's
30 written instructions.
31 3.3 FIELD QUALITY CONTROL
32 A. Inspection Agency: **Owner may engage** a qualified inspector to perform inspections and to furnish reports to
33 Architect.
34 B. Inspections:
35 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
36 C. Repair or remove and replace installations where inspections indicate that they do not comply with specified
37 requirements.
38 D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply
39 with specified requirements.
40 E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each
41 item listed in **NFPA 80 and NFPA 101**.
42 3.4 REPAIR
43 A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply
44 touchup of compatible air-drying, rust-inhibitive primer.
45 B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.
46
47
48

END OF SECTION

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SECTION 08 17 43
FRP / ALUMINUM HYBRID DOORS AND FRAMES

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29 PART 1 – GENERAL

30
31 1.1 SUMMARY
32 A. Section Includes:
33 1. Pebble Grain FRP/ Aluminum Hybrid Door installed in Thermally Broken Aluminum Framing.
34 1.2 RELATED SECTIONS
35 A. Section 08 06 71 – Door Hardware Schedule.
36 B. Section 08 06 80 – Glazing Schedule.
37 C. Section 08 10 00 – Doors and Frames.
38 D. Section 08 12 16 – Aluminum Frames.
39 E. Section 08 71 00 – Door Hardware.
40 1.3 REFERENCES
41 A. AAMA 1304 – Voluntary Specification for Forced Entry Resistance of Side-Hinged Door Systems.
42 B. AAMA 1503-98 – Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall
43 Sections.
44 C. ANSI A250.4 – Test Procedure and Acceptance Criteria for Physical Endurance of Steel Doors and Hardware
45 Reinforcing.
46 D. ASTM-B117 – Standard Practices for Operating Salt Spray (Fog) Apparatus.
47 E. ASTM-B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
48 F. ASTM-B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
49 G. ASTM-C518 – Standard test Method for Steady-State Thermal Transmission Properties by Means of Heat Flow
50 Meter Apparatus.
51 H. ASTM-D256 – Standard Test Methods for Determining the Pendulum Impact Resistance of Plastics.
52 I. ASTM-D570 – Standard Test Method for Water Absorption of Plastics.
53 J. ASTM-D638 – Standard Test Method for Tensile Properties of Plastics.
54 K. ASTM-D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical
55 Insulating Materials.
56 L. ASTM-D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
57 M. ASTM-D1622 – Standard Test Method for Apparent Density of Rigid Cellular Plastics.
58 N. ASTM-D1623 – Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.

- 1 O. ASTM-D2126 – Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- 2 P. ASTM-D2583 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- 3 Q. ASTM-D3029 – Test Methods for Impact Resistance of Flat Rigid Plastic Specimens by Means of a Tup (Falling
- 4 Weight) (Withdrawn 1995) (Replaced by ASTM-D5420).
- 5 R. ASTM-D5116 – Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from
- 6 Indoor Materials/ Products.
- 7 S. ASTM-D5420 – Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker
- 8 Impacted by a Falling Weight (Gardner Impact).
- 9 T. ASTM-D6670 – Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor
- 10 Materials/ Products.
- 11 U. ASTM-E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- 12 V. ASTM-E90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building
- 13 Partitions.
- 14 W. ASTM-E283 – Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls,
- 15 and Doors Under Specified Pressure Differences Across the Specimen.
- 16 X. ASTM-E330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by
- 17 Uniform Static Air Pressure Difference.
- 18 Y. ASTM-E1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm
- 19 Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
- 20 Z. ASTM-E1996 – Standard Specification for Performance of Exterior Windows, Glazed Curtain Walls, Doors and Storm
- 21 Shutters Impacted by Wind Borne Debris in Hurricanes.
- 22 AA. ASTM-F476 – Standard Test Methods for Security of Swinging Door Assemblies.
- 23 BB. ASTM-F1642-04 – Standard Test Method for Glazing Systems Subject to Air Blast Loading.
- 24 CC. NWWDA T.M. 7-90 – Cycle Slam Test Method
- 25 DD. NFRC 100 – Procedure for Determining Fenestration Products U-Factors.
- 26 EE. NFRC 400 – Procedure for Determining Fenestration Products Air Leakage.
- 27 FF. TAS 201 – Impact Test Procedures.
- 28 GG. TAS 202 – Criteria for Testing Impact & Nonimpact Resistant Building Envelope Components Using Uniform Static
- 29 Air Pressure.
- 30 HH. TAS 203 – Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
- 31 1.4 SUBMITTALS
- 32 A. Product Data.
- 33 1. Submit manufacturer’s product data sheets, catalog pages illustrating the products, description of
- 34 materials, components, fabrication, finishes, installation instructions, and applicable test reports.
- 35 B. Shop Drawings.
- 36 1. Submit manufacturer’s shop drawings, including elevations, sections, and details indicating dimensions,
- 37 tolerances, materials, fabrication, doors, panels, framing, hardware schedule, and finish.
- 38 C. Samples.
- 39 1. Submit manufacturer’s door sample composed of door face sheet, core, framing and finish.
- 40 2. Submit manufacturer’s sample of standard colors for door face and frame.
- 41 D. Testing and Evaluation Reports.
- 42 E. Submit testing reports and evaluations provided by manufacturer conducted by and accredited independent testing
- 43 agency certifying doors and frames comply with specified performance requirements.
- 44 F. Operation and Maintenance Manual.
- 45 1. Submit manufacturer’s maintenance and cleaning instructions for doors and frames, including maintenance
- 46 and operating instructions for hardware.
- 47 G. Warranty Documentation.
- 48 1. Submit manufacturer’s standard warranty.
- 49 1.5 QUALITY ASSURANCE
- 50 A. Manufacturer’s Qualifications.
- 51 1. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 25
- 52 years concurrent successful experience.
- 53 2. Door and frame components must be fabricated by same manufacturer.
- 54 1.6 DELIVERY, STORAGE, AND HANDLING
- 55 A. Delivery.
- 56 1. Deliver materials to site in manufacturer’s original, unopened, containers and packaging.
- 57 2. Labels clearly identifying opening, door mark, and manufacturer.
- 58 B. Storage.

- 1 1. Store materials in a clean, dry area, indoors in accordance with manufacturer's instructions.
- 2 C. Handling.
- 3 1. Protect materials and finish from damage during handling and installation.
- 4 1.7 WARRANTY
- 5 A. Warrant doors, frames, and factory installed hardware against failure in materials and workmanship, including
- 6 excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in
- 7 excess of normal weathering.
- 8 B. Standard Period.
- 9 1. Ten years.
- 10 C. Limited lifetime
- 11 1. Covers failure of corner joinery, core deterioration, and delamination or bubbling of door skin and corrosion
- 12 of all-fiberglass products while the door is in its specified application in its original installation.
- 13 D. Finish
- 14 1. Anodized, aluminum:10 years.

15
16 PART 2 - PRODUCTS

- 17
- 18
- 19 2.1 FRP/ALUMINUM HYBRID DOORS
- 20 A. Manufacturer.
- 21 1. Special-Lite, Inc.
- 22 2.2 DESCRIPTION
- 23 A. Model
- 24 1. SL-17 Pebble Grain FRP/ Aluminum Hybrid Door.
- 25 B. Construction.
- 26 1. Door Thickness.
- 27 a. 1-3/4".
- 28 2. Stiles & Rails.
- 29 a. Aluminum extrusions made from 6063 aluminum alloys with a minimum temper of T5.
- 30 b. Minimum 2-5/16" deep one-piece extrusion with have integral reglets to accept face sheet on both
- 31 interior and exterior side of door which secure face sheet into place and permit flush appearance.
- 32 c. Screw or snap in place applied caps are not acceptable.
- 33 d. Top rails must have integral legs for interlocking continuous extruded aluminum flush cap.
- 34 e. Bottom rails must have integral legs for interlocking continuous weather bar with single nylon brush
- 35 weather stripping or manually adjustable SL-301 door bottom with two nylon brush weather
- 36 stripping.
- 37 f. Meeting stiles to include integral pocket to accept pile brush weather seal.
- 38 3. Corners.
- 39 a. Mitered.
- 40 b. Secured with 3/8" diameter full-width steel tie rod through extruded splines top and bottom which
- 41 are integral to standard tubular shaped rails.
- 42 c. 1-1/4" x 1-1/4" x 3/16" 6061 aluminum angle reinforcement at corner to give strong, flat surface for
- 43 locking hex nut to bear on.
- 44 d. Weld, glue, or other methods of corner joinery are not acceptable.
- 45 4. Core.
- 46 a. Poured-in-place polyurethane foam.
- 47 b. Laid in foam cores are not acceptable.
- 48 c. Foam Plastic Insulated Doors: IBC 2603.4.
- 49 1) Foam plastic shall be separated from the interior of a building by an approved thermal
- 50 barrier.
- 51 2) Approved thermal barrier must meet the acceptance criteria of the Temperature
- 52 Transmission Fire Test and Integrity Fire Test as stated in NFPA 275.
- 53 3) IBC 2603.4.1.7 foam plastic insulation, having a flame spread index less than 75 and a smoke
- 54 developed index of not more than 450 shall be permitted as a door core when the face is
- 55 metal minimum 0.032" aluminum or 0.016" steel.
- 56 4) Standard door assembly can be tested to show it meets these requirements without the use
- 57 of thermal barrier. If no independent testing conducted all doors with foam plastic core
- 58 must have a thermal barrier.

- 1 5. Face Sheet.
- 2 a. Exterior
- 3 1) 0.120" thick, pebble texture, through color FRP sheet.
- 4 2) Class C standard.
- 5 b. Interior
- 6 1) 0.120" thick, pebble texture, through color FRP sheet.
- 7 2) Class C standard.
- 8 c. Attachment of face sheet.
- 9 1) Extruded stiles and rails to have integral reglets to accept face sheet on both interior and
- 10 exterior side of door which secure face sheet into place and permit flush appearance.
- 11 2) Use of glue to bond face sheet to core or extrusions is not acceptable.
- 12 6. Cutouts.
- 13 a. Manufacture doors with cutouts for required vision lites.
- 14 7. Hardware.
- 15 a. Pre-machine doors in accordance with templates from specified hardware manufacturers.
- 16 8. Reinforcements.
- 17 a. Aluminum extrusions made from 6061 or 6063 aluminum alloys.
- 18 b. Sheet and plate to conform to ASTM-B209.
- 19 c. Alloy and temper to be selected by manufacturer for strength, corrosion resistance, and application
- 20 of required finish, and control of color.
- 21 d. Bars and tubes to meet ASTM-B221.
- 22 C. Sustainability Characteristics.
- 23 1. LEED Declaration.
- 24 a. All aluminum extrusions are produced using prime-equivalent billet produced from 100%
- 25 reprocessed 6063-T6 alloy recovered from industrial processes. The USGBC classifies these
- 26 extrusions as pre-consumer recycled material.
- 27 b. Manufacturing facility located within 500 miles of major components and materials, including
- 28 aluminum extrusions.
- 29 c. The point of recovery and smelting of pre-consumer recycled material within 500 miles of the
- 30 manufacturing facility.
- 31 2.3 FRAMING
- 32 A. Framing
- 33 1. Thermally Broken Aluminum Framing.
- 34 a. Model.
- 35 1) SL-600TB
- 36 b. Perimeter Frame Members.
- 37 1) Storefront frame with thermally broken pocket filler
- 38 2) Factory fabricated.
- 39 3) Open-back framing is not acceptable.
- 40 c. Thermal Strut.
- 41 1) Fiber reinforced plastic, no other materials will be accepted.
- 42 d. Applied Door Stops.
- 43 1) 5/8" x 1-1/4" or 5/8" x 1-3/4", 0.125" wall thickness, with screws and weather-stripping.
- 44 2) Provide solid 1/2" aluminum bar behind door stop for closer shoe attachment.
- 45 3) Pressure gasketing for weathering seal.
- 46 4) Counterpunch fastener holes in door stop to preserve full-metal thickness under fastener
- 47 head.
- 48 5) Minimum 1/2" aluminum bar reinforcement under doorstop for required hardware
- 49 attachments, aluminum to meet ASTM-B221.
- 50 e. Caulking.
- 51 1) Caulk joints before assembling frame members
- 52 f. Frame Member to Member Connections
- 53 1) Secure joints with fasteners.
- 54 2) Provide hairline butt joint appearance.
- 55 3) Shear block construction only, no screw spline allowed.
- 56 g. Hardware
- 57 1) Pre-machine and reinforce frame members for hardware in accordance with and door
- 58 hardware schedule.

- 1 2) Surface mounted closures shall be reinforced at factory.
2 h. Anchors:
3 1) Anchors appropriate for wall conditions to anchor framing to wall materials.
4 2) Door Jamb and Header Mounting Holes: Maximum of 24-inch centers.
5 3) Secure head and sill members of transom, side lites, and similar conditions.
- 6 2.4 PERFORMANCE
7 A. Face Sheet.
8 1. Standard Interior and Exterior Class C 0.120" thick, pebble texture, through color FRP sheet.
9 a. Flexural Strength, ASTM-D790: 21×10^3 psi.
10 b. Flexural Modulus, ASTM-D790: 0.7×10^6 psi.
11 c. Tensile Strength, ASTM-D638: 13×10^3 psi.
12 d. Tensile Modulus, ASTM-D638: 1.2×10^6 psi.
13 e. Barcol Hardness, ASTM-D2583: 55.
14 f. Izod Impact, ASTM-D256: 14.0 ft-lb/in.
15 g. Gardner Impact Strength, ASTM-D5420: 120 in-lb.
16 h. Water Absorption, ASTM-D570: 0.20%/24hrs at 77°F.
17 i. Surface Burning, ASTM-E84: Flame Spread ≤ 200 , Smoke Developed ≤ 450 .
18 j. Taber Abrasion Resistance, Taber Test: 0.007% Max Wt. Loss, cs-17 wheels, 1000g. Wt., 25 cycles.
19 k. Chemical Resistance.
20 1) Excellent Rating.
21 a) Acetic Acid, Concentrated.
22 b) Acetic Acid, 5%.
23 c) Bleach Solution.
24 d) Detergent Solution.
25 e) Distilled Water.
26 f) Ethyl Acetate.
27 g) Formaldehyde.
28 h) Heptane.
29 i) Hydrochloric Acid, 10%.
30 j) Hydrogen Peroxide, 3%.
31 k) Isooctane.
32 l) Lactic Acid, 10%.
- 33 B. Door Core.
34 1. Density, ASTM-D1622: ≤ 5.0 pcf.
35 2. Compressive Properties, ASTM-D1621: Compressive Strength ≥ 60 psi, Compressive Modulus ≥ 1948 psi.
36 3. Tensile and Tensile Adhesion Properties, ASTM-D1623: Tensile Adhesion, 3" x 3" FRP Facers ≥ 53 psi, Tensile
37 Adhesion, 1" x 1" Foam ≥ 104 psi.
38 4. Thermal and Humid Aging, ASTM-D2126: Volume Change at 158 °F, 100% humidity, 14 days $\leq 13\%$.
39 5. Thermal Conductivity, ASTM-C518, Thermal Resistance ≥ 0.10 m²K/W.
- 40 C. Door Panel.
41 1. Thermal Transmittance, AAMA 1503-98: U-Factor = 0.29 Btu/hr-ft²-°F, CRFp = 55.
42 2. Indoor Air Quality, ASTM-D5116, ASTM-D6607: GreenGuard, GreenGuard Gold.
- 43 D. Door and Thermally Broken Aluminum Frame Assembly.
44 1. Thermal Transmittance, NFRC 100.
45 a. Opaque Swinging Door (< than 50% glass)
46 1) U-Factor = 0.31 Btu/hr-ft²-°F.
47 b. Commercially Glazed Swinging Entrance Door (> than 50% glass)
48 1) U-Factor = 0.64 Btu/hr-ft²-°F.
49 2. Air Leakage, NFRC 400, ASTM-E283.
50 a. Opaque Swinging Door (< than 50% glass)
51 1) 0.01 cfm/sqft @ 1.57 psf.
52 2) 0.01 cfm/sqft @ 6.24 psf.
53 b. Commercially Glazed Swinging Entrance Door (> than 50% glass)
54 1) 0.38 cfm/sqft @ 1.57 psf.
55 2) 0.73 cfm/sqft @ 6.24 psf.
56 3. Sound Transmission, ASTM-E90: STC = 30, OITC = 29.
- 57 2.5 MATERIALS
58 A. Aluminum Members.

1. Aluminum extrusions made 6061 or 6063 aluminum alloys.
 2. Sheet and plate to conform to ASTM-B209.
 3. Alloy and temper to be selected by manufacturer for strength, corrosion resistance, and application of required finish, and control of color.
 - B. Fasteners.
 1. All exposed fasteners will have a finish to match material being fastened.
 2. 410 stainless steel or other non-corrosive metal.
 3. Must be compatible with items being fastened.
 - 2.6 FABRICATION
 - A. Factory Assembly.
 1. Door and frame components from the same manufacturer
 2. Required size for door and frame units, shall be as indicated on the drawings.
 3. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
 4. All cut edges to be free of burs.
 5. Welding of doors or frames is not acceptable.
 6. Maintain continuity of line and accurate relation of planes and angles.
 7. Secure attachments and support at mechanical joints with hairline fit at contact surfaces
 - B. Shop Fabrication
 1. All shop fabrication to be completed in accordance with manufactures process work instructions.
 2. Quality control to be performed before leaving each department.
 - 2.7 FINISHES
 - A. Door.
 1. FRP Face Sheets
 - a. Through color.
 - 1) Color.
 - B. Frame
 1. Aluminum.
 - a. Anodizing.
 - 1) Class 1 Anodizing, minimum 0.7 mils thick.
 - a) Color: Clear 215 R1, AA-M10C12C22A41
- PART 3 - EXECUTION
- 3.1 EXAMINATION
 - A. Examine areas to receive doors.
 - B. Notify architect of conditions that would adversely affect installation or subsequent use.
 - C. Do no proceed with installation until unsatisfactory conditions are corrected.
- 3.2 PREPARATION
 - A. Ensure openings to receive frames are plumb, level, square, and in tolerance.
- 3.3 ERECTION
 - A. Install doors in accordance with manufacturer's instructions.
 - B. Install doors plumb, level, square, true to line, and without warp or rack.
 - C. Anchor frames securely in place.
 - D. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by architect.
 - E. Set thresholds in bed of mastic and back seal.
 - F. Install exterior doors to be weathertight in closed position.
 - G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by architect.
 - H. Remove and replace damaged components that cannot be successfully repaired as determined by architect.
- 3.4 FIELD QUALITY CONTROL
 - A. Manufacturer's Field Services.
 1. Manufacturer's representative shall provide technical assistance and guidance for installation of doors.
- 3.5 ADJUSTING
 - A. Adjust doors, hinges, and locksets for smooth operation without binding.
- 3.6 CLEANING
 - A. Clean doors promptly after installation in accordance with manufacturer's instructions.
 - B. Do not use harsh cleaning materials or methods that would damage finish.

- 1 3.7 PROTECTION
- 2 A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration
- 3 at time of substantial completion.
- 4
- 5
- 6

END OF SECTION

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SECTION 08 31 13
ACCESS DOORS AND FRAMES

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9 2.1 PERFORMANCE REQUIREMENTS 1
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17 3.2 INSTALLATION 2
18 3.3 ADJUSTING 2

19
20 PART 1 – GENERAL
21
22 1.1 SUMMARY
23 A. Section Includes:
24 1. Access doors and frames.
25 2. Fire-rated access doors and frames.
26 B. Related Requirements:
27 1. Section 077200 "Roof Accessories" for roof hatches.
28 1.2 SUBMITTALS
29 A. Product Data: For each type of product.
30 1. Include construction details, **fire ratings**, material descriptions, dimensions of individual components and
31 profiles, and finishes.
32 B. Product Schedule: For access doors and frames.
33 C. Qualification Data: For testing and inspecting agency.
34 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
35 D. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.
36 1.3 QUALITY ASSURANCE
37 A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies
38 meets the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
39

40 PART 2 - PRODUCTS
41
42
43 2.1 PERFORMANCE REQUIREMENTS
44 A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified
45 testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.
46 2.2 ACCESS DOORS AND FRAMES
47 A. Flush Access Doors with Concealed Flanges:
48 1. Description: Face of door flush with frame; with concealed flange for **gypsum board** installation and
49 concealed hinge.
50 2. Optional Features: **Piano hinges**.
51 3. Locations: **Wall and ceiling**.
52 4. Uncoated Steel Sheet for Door: **Nominal 0.060 inch, 16 gage**, factory **primed**.
53 5. Stainless Steel Sheet for Door: **Nominal 0.062 inch, 16 gage**, ASTM A480/A480M No. 4 finish.
54 a. For use in shower rooms
55 6. Frame Material: **Same material and thickness as door**.
56 7. Latch and Lock: **Cam latch, screwdriver operated**.
57 2.3 FIRE-RATED ACCESS DOORS AND FRAMES
58 A. Fire-Rated, **Flush** Access Doors with Exposed Flanges:

- 1 2.1 Description: Door face flush with frame, **uninsulated**; with exposed flange, self-closing door, and concealed hinge.
- 2
- 3 2.2 Optional Features: **Piano hinges and masonry anchors**.
- 4 2.3 Locations: **Wall**.
- 5 2.4 Fire-Resistance Rating: Not less than **1 hour**.
- 6 2.5 Uncoated Steel Sheet for Door: **Nominal 0.036 inch, 20 gage**, factory **primed**.
- 7 2.6 Frame Material: **Same material, thickness, and finish as door**.
- 8 2.7 Latch and Lock: Self-latching door hardware, **operated by knurled-knob**.

9 **2.4 MATERIALS**

- 10 A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- 11 B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- 12 C. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, **Type 304**. Remove tool and die marks and stretch lines, or blend into finish.
- 13 D. Stainless Steel Flat Bars: ASTM A666, **Type 304**. Remove tool and die marks and stretch lines, or blend into finish.
- 14 E. Frame Anchors: Same material as door face.
- 15 F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

16 **2.5 FABRICATION**

- 17 A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- 18 B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- 19 C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 20 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- 21 D. Latch and Lock Hardware:
 - 22 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

23 **2.6 FINISHES**

- 24 A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 25 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 26 C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- 27 D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 28 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- 29 E. Stainless Steel Finishes:
 - 30 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 31 2. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.

32 **PART 3 - EXECUTION**

33 **3.1 EXAMINATION**

- 34 A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 35 B. Proceed with installation only after unsatisfactory conditions have been corrected.

36 **3.2 INSTALLATION**

- 37 A. Comply with manufacturer's written instructions for installing access doors and frames.

38 **3.3 ADJUSTING**

- 39 A. Adjust doors and hardware, after installation, for proper operation.

40 **END OF SECTION**

**SECTION 08 33 15
HIGH-PERFORMANCE HIGH-SPEED DOORS**

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.2 CONDITIONS OF THE CONTRACT

- A. Conditions of the contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.3 SUMMARY

- A. Provide high-performance, insulated, fabric-style, exterior overhead high-speed doors.
B. System shall include all doors, operational components, motors, frames, safety components, controls, finishes, signal lights and related items for a complete installation.
C. Refer to the drawings for locations, sizes, and conditions.

1.4 RELATED SECTIONS

- A. Division 26 - Electrical.

1.5 REFERENCES

- A. ASTM E 330-14 - Standard Test Method for Structural Performance of Exterior Doors.
B. ASTM E 547 - Standard Method for Water Penetration of Exterior Doors.
C. ANSI/DASMA 105-212 – Standard Method for Thermal Transmittance and Infiltration of Exterior Doors.
D. ANSI/DASMA 108-212 – Standard Method for Testing Sectional Garage Doors and Rolling Doors.
E. NEMA – All applicable sections
F. UL Listed - Underwriters Laboratories Inc. Product Listed.

1.6 DESIGN / PERFORMANCE REQUIREMENTS

- A. System shall conform to the following criteria:
 - 1. Static Pressure Resistance: Design door assembly to withstand ultimate static pressure load of 100 psf (478 Pa) at 15 feet wide, in conformance to ASTM E 330.
 - 2. Dynamic Pressure Resistance: Design door assembly to be able to operate under constant dynamic pressure load of 5 psf (239.4 Pa) for all available sizes.
- B. Single-Source Responsibility: Provide doors, guides, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Details of door materials, construction, and fabrication.
 - 4. Operating characteristics, electrical characteristics, and furnished accessories. Include automatic closing devices and testing and resetting instructions.
 - 5. Installation instructions.
- B. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.
- C. Selection Samples: For each finish specified, two complete sets of color chips representing manufacturer's full range of available colors and finishes.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Closeout Submittals: Provide manufacturer's maintenance instructions including a detailed parts lists and maintenance recommendations.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of 5 years experience in the fabrication and installation of security closures.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum 5 years and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

1.10 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.11 COORDINATION

- A. Coordinate work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.12 WARRANTY

- A. Warranty: Manufacturer's standard limited door warranty and operator system to be free of defects in material and workmanship for 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide doors systems from one of the following manufacturers:
 - 1. Hormann.
 - 2. Overhead Door Corporation.
 - 3. Rytec.

4. Approved equal.

2.2 MATERIALS AND SYSTEM COMPONENTS

- A. Model: As a basis of design, the specification is based on Hormann Speed Master Series, Model 1600 XL roll up door:
 1. Performance:
 - a. Opening Speed: Door to operate at a variable speed up to 80 inches (2032 mm) per second (control system dependent) with a minimum of 40 inches per second.
 - b. Closing Speed: Door to operate at a variable speed up to 20 inches (508 mm) per second.
 - c. Operation Cycles: Drive motor and gearbox capable of operating for not less than 500,000 cycles. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - d. Doors shall be designed for a minimum of 100 cycles per day.
 2. Door Curtain Design:
 - a. Solid Panel(s): Panel shall be a sectional design using a rectangular vinyl reinforced sheet material joined at top and bottom edges by two-piece aluminum hinges that mechanically clamp and retain panel fabric.
 - b. Material: Abrasion resistant, 2-ply polyester reinforced "Commander" PVC sheet.
 - c. Thickness: 0.110" (2.8 mm). 3) Weight: 58 oz./yd². 4) Temperature Resistance: -22° F to +158° F, must maintain flexibility and stability.
 - d. Color Availability: As selected by the Architect from a minimum of 5 colors.
 - e. Lighter weight, single ply, polyurethane or rubber panels will not be accepted
 - f. Door Curtain: Double-Walled 6063-T6 Aluminum, 5.8 inch by 1.2 inch thick, with interior face also using 6063-T6 aluminum for the hinge system. Doors that use hinges not made of metal will not be accepted. Door will have UV-Resistant weatherseal between aluminum panel sections.
 - g. Finish: Powder coat finish in color, minimum of 2.5 mils, as selected by the Architect from a minimum of 5 colors.
 3. Bottom Bar: 6063-T6 Aluminum with integrated wireless sensing edge.
 - a. Finish: To match door.
 - b. Provide door with a wireless failsafe electric safety edge.
 4. Guides: Construct of structural steel, high strength steel cover with structural aluminum track. Provide manufacturer's standard construction for a complete installation.
 - a. Finish: To match door.
 - b. Door shall have no visible air gaps along the side or top of the door when door panel is in the closed or down position.
 - c. Guides will have weather seal on entire height of door panel.
 - d. Springless System: No springs permitted to assist operation of the door. Guides with enclosed spring must not be accepted due to maintenance, reliability and life cycle issues.
 5. Door Header: Head plates with structural steel truss system spanning the width of the opening. Brackets made of structural Steel and powder-coated finish with self-aligning bearings.
 - a. Truss System: Pre-fabricated structure made of structural steel and powder-coated finish.
 - b. Header Door Track: Design that is of concentric circular shape and appropriate spacing to prevent metal-to-metal contact of slats on each concentric loop for smooth door movement and minimal noise. Doors with header track made of aluminum will not be accepted due to potential strength and fatigue issues for load-bearing.
 - c. Brackets, frames, seals and attachment: Manufacturer's standard method of attachment and structure.
 - d. Finish: Baked-on Polyester powder coat, minimum of 2.5 mils.
 6. Fascia:
 - a. Finish: Powder coat to match door.
 - b. Material: Galvanized 22 gauge steel .
 - c. Electric Door Operator: UL listed.
 - d. Usage Classification: Heavy-duty, rated up to 60 cycles per hour under constant load.
 - e. Motor Exposure: Exterior / Interior use.

- f. Direct Side Mounted: Operator mounted directly to door drive shaft to the left or right side of the door. No chain and sprocket allowed.
 - g. Electrical Characteristics: Phase and Voltage: 3-Phase 460/480V AC
 - h. Operator: Minimum 1.0 horsepower. Motor and gearbox designed for high cycle operation with built-in gearbox failure door stop safety device.
 - i. Hand Chain: Manual brake disengagement pull switch and hand chain which allows door to be manually opened and closed during a power outage and installation.
 - j. Limit System: Magnetic type providing absolute positioning with push to set and remote setting capabilities. Limit system shall remain synchronized with the door during manual operation and supply power interruptions.
 - k. Timer to Close: Each door to have automatic closing controlled by an *adjustable* hold open time delay.
7. Control System:
- a. Microprocessor based with variable frequency drive controller, capable of variable speed control in both up and down directions. System incorporates a Liquid Crystal Display (LCD) to display the system status.
 - b. Capable of monitoring and reporting on a variety of operating conditions, including: Current operating status, Current command status, Current error status (if applicable), Hoist interlock status (if applicable), Service reminder status, and 24VDC status.
 - c. Control system is housed in a NEMA 4X panel with built-in push buttons and main power padlock-able rotary disconnect switch.
8. Operation and Associated devices: Provide loops at the access side of the doors. Refer to drawings for entry point and location. Loops shall activate doors and a closer shall close the doors.
- a. Provide override for the owner to keep the door open as desired.
9. Activation Devices: Provide for condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.
- a. Pedestrian 3 button switch (up-down-hold).
10. Provide signal unit at the opening side of the door with both red and green lights. Unit shall be weather-tight and controlled so that the light stay red until the door is fully in the open position. When fully opened, the green light shall remain on until the moment the door closes.
11. Safety Devices: Provide for condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate safety devices with door operation and door operator mechanisms.
- a. Provide bottom bar activation unit.
12. Seals and Weatherstripping: Provide seals and weatherstripping at all joints, terminations and interconnection including door panels, sides of panels, door head, door bottom.
- a. Provide exterior vinyl stripping at door jambs and head using manufacturer's standard flexible material. Color as selected by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Prior to the start of the installation, verify opening sizes, tolerances and conditions are acceptable.
- B. Verify site electrical characteristics and supplies.
- C. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

- A. Install system with strict accordance with manufacturer's instructions. Contact the manufacturer if any condition or system component is questionable or does not conform to the instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Install perimeter trim and closures.
- G. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

- H. Perform initial operations to ensure that the system is free of operational issues. If any problems are noted, contact the manufacturer for guidance and information on correcting any issue.

3.3 ADJUSTING

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.
- C. Adjust seals to provide tight fit around entire perimeter.

3.4 CLEANING

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 DEMONSTRATION

- A. Arrange with the owner so that an authorized service representative can perform training. Provide information to the Owner on maintenance, operation and trouble-shooting.

3.6 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

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**SECTION 08 33 23
 OVERHEAD COILING DOORS**

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27
 28 PART 1 – GENERAL
 29
 30 1.1 SUMMARY
 31 A. Section Includes:
 32 1. Service doors.
 33 2. Fire-rated service doors.
 34 B. Related Requirements:
 35 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards,
 36 and bollards.
 37 1.2 SUBMITTALS
 38 A. Product Data: For each type and size of overhead coiling door and accessory.
 39 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats,
 40 and finishes.
 41 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 42 3. Include description of automatic-closing device and testing and resetting instructions.
 43 B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's
 44 product data.
 45 1. Include plans, elevations, sections, and mounting details.
 46 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field
 47 assembly, components, and location and size of each field connection.
 48 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 49 4. For exterior components, include details of provisions for assembly expansion and contraction and for
 50 excluding and draining moisture to the exterior.
 51 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
 52 6. Include diagrams for power, signal, and control wiring.
 53 C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for
 54 units with factory-applied finishes.
 55 1. Include similar Samples of accessories involving color selection.
 56 D. Qualification Data: For Installer.
 57 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
 58 E. Sample Warranty: For special warranty.

- 1 F. Special warranty.
- 2 G. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- 3 H. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door
- 4 accesses.
- 5 1.3 QUALITY ASSURANCE
- 6 A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by
- 7 manufacturer for both installation and maintenance of units required for this Project.
- 8 B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies
- 9 is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
- 10 1.4 WARRANTY
- 11 A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or
- 12 workmanship within specified warranty period.
- 13 1. Warranty Period: Two years from date of Substantial Completion.
- 14

15 PART 2 - PRODUCTS

- 16
- 17
- 18 2.1 MANUFACTURERS
- 19 A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
- 20 1. Obtain operators and controls from overhead coiling-door manufacturer.
- 21 2.2 PERFORMANCE REQUIREMENTS
- 22 A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-
- 23 protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or
- 24 UL 10B.
- 25 B. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible
- 26 Design" and ICC A117.1
- 27 C. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
- 28 1. Design Wind Load: As indicated on Drawings.
- 29 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing
- 30 permanent deformation or disengagement of door components.
- 31 2.3 DOOR ASSEMBLY
- 32 A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
- 33 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that
- 34 may be incorporated into the Work include, but are not limited to the following:
- 35 a. Cookson; a CornellCookson company.
- 36 b. Hormann High Performance Doors.
- 37 c. McKeon Door Company.
- 38 d. Overhead Door Corporation.
- 39 e. Raynor Garage Doors.
- 40 f. Wayne Dalton; a division of Overhead Door Corporation.
- 41 B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation
- 42 cycle is complete when a door is opened from the closed position to the fully open position and returned to the
- 43 closed position.
- 44 C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to
- 45 ASTM E283.
- 46 D. Door Curtain Material: Galvanized steel.
- 47 E. Door Curtain Slats: Flat profile slats.
- 48 F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick. fabricated from hot-dip galvanized
- 49 steel and finished to match door>.
- 50 G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- 51 H. Hood: Match curtain material and finish.
- 52 1. Shape: Round.
- 53 2. Mounting: Face of wall.
- 54 I. Electric Door Operator:
- 55 1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
- 56 2. Operator Location: Top of hood.
- 57 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
- 58 4. Motor Exposure: Interior and Exterior, wet, and humid.

- 1 5. Motor Electrical Characteristics:
- 2 a. Horsepower: 1 hp.
- 3 b. Voltage: 208 V ac, three phase, 60 Hz.
- 4 6. Emergency Manual Operation: Chain type.
- 5 7. Obstruction-Detection Device: Automatic photoelectric sensor and electric sensor edge on bottom bar.
- 6 a. Sensor Edge Bulb Color: Black.
- 7 8. Control Station(s): Interior mounted.
- 8 J. Curtain Accessories: Equip door with weatherseals, pole hook and automatic-closing device.
- 9 K. Door Finish:
- 10 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
- 11 2.4 FIRE-RATED DOOR ASSEMBLY
- 12 A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
- 13 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that
- 14 may be incorporated into the Work include, but are not limited to the following:
- 15 a. Cookson; a CornellCookson company.
- 16 b. Hormann High Performance Doors.
- 17 c. McKeon Door Company.
- 18 d. Overhead Door Corporation.
- 19 e. Raynor Garage Doors.
- 20 f. Wayne Dalton; a division of Overhead Door Corporation.
- 21 B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation
- 22 cycle is complete when a door is opened from the closed position to the fully open position and returned to the
- 23 closed position.
- 24 C. Fire Rating: 2 hour.
- 25 D. Door Curtain Material: Galvanized steel.
- 26 E. Door Curtain Slats: Flat profile slats.
- 27 F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized
- 28 steel and finished to match door.
- 29 G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- 30 H. Hood: Match curtain material and finish.
- 31 1. Shape: Round.
- 32 2. Mounting: Face of wall.
- 33 I. Electric Door Operator:
- 34 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
- 35 2. Operator Location: Top of hood.
- 36 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
- 37 4. Motor Exposure: Interior.
- 38 5. Motor Electrical Characteristics:
- 39 a. Horsepower: 1 hp.
- 40 b. Voltage: 208 V ac, three phase, 60 Hz.
- 41 6. Emergency Manual Operation: Chain type.
- 42 7. Obstruction-Detection Device: Automatic photoelectric sensor and electric sensor edge on bottom bar.
- 43 a. Sensor Edge Bulb Color: Black.
- 44 8. Control Station(s): Exterior mounted.
- 45 J. Curtain Accessories: Equip door with smoke seals, automatic-closing device, and pole hook.
- 46 K. Door Finish:
- 47 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
- 48 2.5 MATERIALS, GENERAL
- 49 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing
- 50 agency, and marked for intended location and application.
- 51 2.6 DOOR CURTAIN MATERIALS AND CONSTRUCTION
- 52 A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind
- 53 loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats
- 54 of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of
- 55 door indicated, and as follows:
- 56 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with
- 57 ASTM A653/A653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71
- 58 mm); and as required.

- 1 B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain
- 2 slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate
- 3 smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to
- 4 prevent overtravel of curtain.
- 5 2.7 HOODS
- 6 A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head.
- 7 Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form
- 8 closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond
- 9 wall face. Equip hood with intermediate support brackets as required to prevent sagging.
- 10 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc
- 11 coating, complying with ASTM A653/A653M.
- 12 2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
- 13 2.8 CURTAIN ACCESSORIES
- 14 A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and
- 15 draft control as required for door listing and labeling by a qualified testing agency.
- 16 B. Pole Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.
- 17 C. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release
- 18 mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release
- 19 mechanism for motor-operated doors allows testing without mechanical release of the door. Automatic-closing
- 20 device is to be designed for activation by the following:
- 21 1. Replaceable fusible links with temperature rise and melting point of 165 deg F interconnected and mounted
- 22 on both sides of door opening.
- 23 2. Building fire-detection, smoke-detection, and -alarm systems.
- 24 2.9 COUNTERBALANCE MECHANISM
- 25 A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel
- 26 helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with
- 27 barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- 28 B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless
- 29 or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without
- 30 distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- 31 C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to
- 32 counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs
- 33 to barrel and shaft with cast-steel barrel plugs.
- 34 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main
- 35 counterbalance spring when automatic-closing device operates.
- 36 D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed
- 37 spring ends and carry torsional load.
- 38 E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.
- 39 2.10 ELECTRIC DOOR OPERATORS
- 40 A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for
- 41 door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter,
- 42 gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking
- 43 door, and accessories required for proper operation.
- 44 1. Comply with NFPA 70.
- 45 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control
- 46 circuit, maximum 24-V ac or dc.
- 47 B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per
- 48 hour indicated for each door.
- 49 C. Door Operator Location(s): Operator location indicated for each door.
- 50 1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of
- 51 the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is
- 52 required for this type of mounting.
- 53 D. Motors: Reversible-type motor for motor exposure indicated for each door assembly.
- 54 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to
- 55 start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec.
- 56 (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service
- 57 factor.

- 1 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard
2 unless otherwise indicated.
- 3 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with
4 building electrical system and each location where installed.
- 5 E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to
6 automatically stop door at fully opened and fully closed positions.
- 7 F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor
8 capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops
9 and reverses downward door travel. For fire-rated doors, activation delays closing.
- 10 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening
11 without contact between door and obstruction.
- 12 a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to
13 or disconnection of sensing device. When self-monitoring feature is activated, door closes only with
14 sustained or constant pressure on close button.
- 15 2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to
16 bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard
17 take-up reel or self-coiling cable.
- 18 a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control
19 circuit to detect damage to or disconnection of sensor edge.
- 20 G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls
21 labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
- 22 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose
23 NEMA ICS 6, Type 1 enclosure.
- 24 H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual
25 operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- 26 I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for
27 automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting
28 motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include
29 interlock device to automatically prevent motor from operating when emergency operator is engaged.
- 30 J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without
31 affecting emergency manual operation.
- 32 K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.
- 33 2.11 GENERAL FINISH REQUIREMENTS
- 34 A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- 35 B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
36 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
37 installed to minimize contrast.
- 38 2.12 STEEL AND GALVANIZED-STEEL FINISHES
- 39 A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and
40 thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment,
41 application, and minimum dry film thickness.
- 42
- 43 PART 3 - EXECUTION
- 44
- 45
- 46 3.1 EXAMINATION
- 47 A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate
48 construction and other conditions affecting performance of the Work.
- 49 B. Examine locations of electrical connections.
- 50 C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 51 3.2 INSTALLATION, GENERAL
- 52 A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts,
53 hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- 54 B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- 55 C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the
56 accessibility standard.
- 57 D. Fire-Rated Doors: Install according to NFPA 80.
- 58 E. Power-Operated Doors: Install according to UL 325.

- 1 3.3 FIELD QUALITY CONTROL
- 2 A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
- 3 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm
- 4 system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
- 5 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
- 6 B. Repair or remove and replace installations where inspections indicate that they do not comply with specified
- 7 requirements.
- 8 C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply
- 9 with specified requirements.
- 10 D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each
- 11 item listed in NFPA 80 and NFPA 101.
- 12 3.4 ADJUSTING
- 13 A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or
- 14 distortion.
- 15 1. Adjust exterior doors and components to be weather resistant.
- 16 B. Lubricate bearings and sliding parts as recommended by manufacturer.
- 17 C. Adjust seals to provide tight fit around entire perimeter.
- 18
- 19
- 20

END OF SECTION

**SECTION 08 36 13
OVERHEAD DOORS**

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PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

- A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 DESCRIPTION OF WORK:

- A. Section includes four types of commercial quality, motorized, overhead doors and tracks including all accessories, as shown on drawings and specified herein, and as follows:
1. Overhead sectional doors with a combination of solid insulated sections and glazed insulated glass aluminum-framed sections, Kynar finish.
- B. Operators, accessories and tracks: In summary, overhead doors shall operate as follows:
1. Door operation, all doors: Each door shall have an internal 3-position switch, located at the interior wall next to the door. Interior door shall have switch at both sides of the door.
 2. Door operation: Loops shall open doors with a timer connected to electric eyes to close the door.
- C. Internal 3-button wall-mounted switch shall be provided at each overhead door.
- D. Provide jack-shaft operators at all sectional OH door locations. Refer to the drawings and verify in advance that the operator will work within the condition. Trolley-type operators will be accepted if the conditions are not acceptable for jack-shaft wall-mounted operators, but only with pre-approval by the Architect.
- E. Provide 3" track (and rollers) for all doors in configurations shown, as applicable at the sectional doors.
- F. Refer to the drawings for configuration of the tracks.
- G. Vision panels: refer to section 2 and the drawings for more details.
- E. This section includes controls, wiring, connections, loops, manual override, closing operation, photo-eye, connections, emergency reverse eyes and other components to complete the work related to the overhead doors.
- F. If horizontal struts / reinforcing is required at the vision panels, by the manufacturer, this must be shown on the shop drawings or this will not be considered acceptable for aesthetic reasons: the manufacturer shall warrant the stability and structural integrity of the door regardless.

1.3 QUALITY ASSURANCE:

- A. Provide all overhead doors as a complete unit produced by one manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, operators and installation accessories, to suit openings and headroom allowable.
- B. Wind Loading: At exterior doors, design and reinforce sectional overhead doors to withstand a 20 lb. per sq. ft. wind load.
- C. Approval: Manufacturers not listed herein shall provide evidence that they are able to meet the intent of the specifications. Provide a full submittal with a listing of five similar projects of similar size and complexity (including specifications for each), list of references and all other requested materials.

- D. Installer: Installer shall be approved and authorized by the manufacturer.
- E. Pre-installation conference: Schedule a pre-installation conference prior to installation of door systems. Establish necessary working conditions and related work for a correct installation.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of overhead door. Provide material on vehicle loop detectors, transmitters, receivers, proximity sensors and other accessories. Include manufacturer's operating instructions and maintenance data.
- B. Shop Drawings: Submit shop drawings for special components and installations which are not fully dimensioned or detailed in manufacturer's data. Indicate all reinforcing, stiles, vision panel size, reinforcement and related items. Include 50,000 cycle guarantee.
- C. Samples: Submit 6" by 6" samples of custom finish color/texture.
- D. Maintenance data and manuals at closeout.

1.5 WARRANTY:

- A. Provide written warranty to cover the following covering the following based on "normal use" by the owner:
 - 1. 1-year coverage of labor and materials for the entire door system
 - 2. 2-year coverage of labor and materials for replacement of any door panel that has rusted.
 - 3. 3-year coverage for 500,00 cycle operation of the high-speed doors.
 - 4. 5-year coverage for delamination of panels, materials- only delivered to the project site
 - 5. 10-year coverage for rusting of panels, materials- only shipped to the project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with all specified requirements, including gages, qualities, accessories and paint finish, provide all doors from one of the following manufacturers:
 - 1. Clopay Door
 - 2. Cookson Door
 - 3. Midland Door
 - 4. Overhead Door
 - 5. Raynor Door
 - 6. Wayne Dalton
 - 7. North Central Door
 - 8. Other manufacturers meeting this specification, as approved

2.2 MATERIALS:

- A. Insulated sectional doors: At all locations, 20 gage G60 galvanized exterior steel face sheets, with a minimum yield strength of 33,000 psi, and a minimum G60 zinc coating complying with ASTM A 525.
 - 1. Flush, non-textured, flat panel doors shall have a powder coat finish in custom color: to match selection of framing for glazed sections.
 - 2. Framing for glazed doors: Extruded aluminum frame stiles and rails shall be provided with Custom Color finish, color as selected by the Architect. Exterior surfaces to be beveled to for drainage. End Stiles: Minimum 16 gauge separated from skin with vinyl thermal break, double end stiles.
 - 4. Insulation at insulated steel door panels: At all insulated doors, the minimum thickness of each door shall be 1-7/8". The insulation shall be the manufacturer's standard, type as recommended by the manufacturer, bonded to steel face sheets. Panels shall be of adequate integrity, of the size shown, to perform under daily use without warping, racking or failing with daily use.
 - 5. Insulation section shall have an R-value minimum of 9.0.
 - 6. Glazing/glass: Insulated vision panels shall be provided at locations shown on the drawings. Refer to Section 08800 for insulated glass requirements. Provide sealed double-glazed glass units where shown of 1/2" minimum thickness, insulated clear glass.
- B. Exterior door panel sections shall include continuous dual weather-stripping, and interlock design at seams and door sections.

2.3 TRACKS, SUPPORTS AND ACCESSORIES:

- A. Tracks: Provide manufacturer's 3" 12 gauge heavy-duty galvanized steel track system at all doors. Provide complete track assembly including brackets, bracing and reinforcing for rigid support of ball bearing roller guides, for required door type and size.
- B. Refer to the drawings for types of tracks and clearance as required on this project.
- C. Track Reinforcement and Supports: Provide galvanized steel track reinforcement and support members. Secure, reinforce and support tracks as required for size and weight of door to provide strength and rigidity, and to ensure against sag, sway, and detrimental vibration during opening and closing of doors.
- D. Support and attach tracks at opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling tracks) with continuous angle welded to track and supported by laterally-braced attachments to overhead structural members at curve and end of tracks.
- E. Weather Seals: At all doors, provide heavy duty, continuous header and side seals anchored to the top panel and side jamb, especially designed to prohibit wind and rain from entering through closed door. Provide color options for Architect's selection.
- F. Section seal to be continuous integral, dual vinyl seals at each panel intersection. Panels shall be designed with interlocking construction to hold seals.
- G. Bottom weather-strip to be flexible bulb-type vinyl or neoprene section held in aluminum retainer, compressible to create a weather-tight seal between door and floor.

2.4 HARDWARE:

- A. At sectional doors, provide heavy-duty, rust-resistant hardware, with galvanized or cadmium-plated or stainless-steel fasteners, to suit type of door.
- B. Hinges: Provide heavy steel hinges at each end stile and at each intermediate stile, per manufacturer's recommendations for size of door. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges, where required, for doors exceeding 16'-0" in width, unless otherwise recommended by door manufacturer.
- C. Rollers: Provide Magnum type heavy-duty 3" rollers, with double sealed steel ball bearings (minimum ten 1/4" balls per roller) in case-hardened chromium-plated steel raceways with stainless steel stems mounted with varying projections to suit slope of track. Tires to be UHMW type. These to be used at all doors. Provide roller length suitable for the dual roller brackets.
- D. Roller brackets: Provide dual galvanized roller brackets.

2.5 COUNTERBALANCING MECHANISMS:

- A. Torsion Spring: At sectional doors provide high cycle, 50,000 cycle type at all doors, certified by the manufacturer, with 3 greaseable pillow block bearing per shaft. Spring design shall be replaceable, no longer than 72" length. Hang door assembly for operation by torsion spring counterbalance mechanism, consisting of adjustable tension tempered steel torsion springs mounted on a case-hardened steel shaft, and connected to door with galvanized aircraft-type lift cable.
- B. Provide cast aluminum or grey iron casting cable drums, grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft with one additional mid-point bracket for shafts up to 16' long and 2 additional brackets at 1/3-points to support shafts over 16' long, unless closer spacing recommended by door manufacturer.
- C. Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side, designed to stop door automatically if either cable breaks. Provide either a compression spring or leaf spring bumper installed at end of each horizontal track to cushion door at end of opening operation.

2.6 DOOR OPERATOR, CONTROLS AND ACCESSORIES:

- A. Jack-shaft operators: At all exterior door locations, provide industrial duty operator enclosed in-oil primary drive, and worm gear secondary drive, with quick disconnect: model shall be equal to Liftmaster Industrial Duty Jack Shaft. Refer to "electric motors" below for additional specifications.
- B. Electric Motors: Provide 1 horsepower (or size as recommended by the manufacturer) at all exterior doors 460/480 Volt, three-phase (*this must be verified with electrical*) heavy duty, high starting torque, reversible, constant duty, Class A insulated electric motors with overload protection, sized to move door in either direction, from any position, at not less than 6" or more than 12" per second. Include all overload protection, limit switches and accessories as required.
- C. Automatic Reversing Control: Provide safety switch, extending full width of door bottom, and located within neoprene or rubber astragal mounted to bottom door rail.

1. Provide photo eye with emitter located high and low (with heights and locations verified by the owner). Unit shall be UL listed with 115 voltage AC power: Sun-X-Thru Beam or equal. Heights must be verified prior to installation.
- D. Door Controls: Performance specification on controls, accessories and features: System accessories and features shall be provided as recommended by the door manufacturer. Contractor of this section shall provide all necessary controls, equipment, accessories and features to the following performances:
 1. Wall-Mounted switches: Provide the 3-button momentary switch at every door. All exterior doors shall include the switch at the interior side of each door only.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install doors, tracks, and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with final shop drawings, manufacturer's instructions and as herein specified.
 1. Prior to installation, coordinate placement of track, door, and accessories with other subcontractors, including mechanical, to avoid conflicts.
 2. Fasten vertical track assembly to framing at not less than 24" o.c. Hang horizontal track from structural overhead framing with angle or channel hangars, welded and bolt-fastened in place. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track and door operating equipment.
 3. Upon completion of installation, including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion, and fitting weather tight for entire perimeter.
- B. Contractor shall adjust or replace materials until specified minimums are met or exceeded. In addition, contractor shall promptly repair door defects until unit is working properly.
- C. Assist Owners with operation and maintenance guidelines to the satisfaction of the Architect and Owner.

END OF SECTION

SECTION 08 41 13
ALUMINUM-FRAMED STOREFRONTS

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24	PART 1 – GENERAL		
25			
26	1.1 SUMMARY		
27	A. Section Includes:		
28	1. Aluminum-framed storefront systems.		
29	1.2 PREINSTALLATION MEETINGS		
30	A. Preinstallation Conference: Conduct conference at Project site.		
31	1.3 SUBMITTALS		
32	A. Product Data:		
33	1. Aluminum-framed entrance and storefront systems.		
34	B. Product Data Submittals: For each product.		
35	1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.		
36	2. For sealants, indicating VOC content.		
37	3. For recycled content, indicating postconsumer and preconsumer recycled content and cost.		
38	4.		
39	C. Shop Drawings:		
40	1. Plans, elevations, sections, full-size details, and attachments to other work.		
41	2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the		
42	assembly to the exterior.		
43	3. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance		
44	and storefront systems, showing the following:		
45	a. Joinery, including concealed welds.		
46	b. Anchorage.		
47	c. Expansion provisions.		
48	d. Glazing.		
49	e. Flashing and drainage.		
50	4. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.		
51	D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each		
52	type of exposed finish.		
53	E. Sustainable Design Submittals:		
54	1. Verify sealant has a VOC content of 250 g/L or less.		
55	2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.		
56	3. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled		
57	content not less than 25 percent.		

- 1 4. Regional Materials: Manufacture products within 100 miles (160 km) of Project site from materials that
- 2 have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of
- 3 Project site.
- 4 5. Environmental Product Declaration: For each product.
- 5 6. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- 6 F. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and
- 7 components, from manufacturer.
- 8 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and
- 9 storefront system.
- 10 G. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by a qualified
- 11 testing agency.
- 12 H. Source Quality-Control Reports: For aluminum-framed entrance and storefront systems.
- 13 I. Field Quality-Control Reports: For aluminum-framed entrance and storefront systems.
- 14 J. Sample Warranties: For aluminum-framed entrance and storefront systems.
- 15 K. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.
- 16 1.4 QUALITY ASSURANCE
- 17 A. Installer Qualifications:
- 18 1. Entity that employs installers and supervisors who are trained and approved by manufacturer.
- 19 B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and
- 20 performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment,
- 21 and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining
- 22 construction.
- 23 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If
- 24 changes are proposed, submit comprehensive explanatory data to Architect for review.
- 25 1.5 WARRANTY
- 26 A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrance and
- 27 storefront systems that fail in materials or workmanship within specified warranty period.
- 28 1. Failures include, but are not limited to, the following:
- 29 a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- 30 2. Warranty Period: Two years from date of Substantial Completion.
- 31 B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or
- 32 replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
- 33 1. Deterioration includes, but is not limited to, the following:
- 34 a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
- 35 b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
- 36 c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- 37 C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or
- 38 replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
- 39 1. Deterioration includes, but is not limited to, the following:
- 40 a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
- 41 b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
- 42 c. Cracking, peeling, or chipping.
- 43 2. Warranty Period: Five years from date of Substantial Completion.
- 44
- 45 PART 2 - PRODUCTS
- 46
- 47
- 48 2.1 SOURCE LIMITATIONS
- 49 A. Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories,
- 50 from single manufacturer.
- 51 2.2 PERFORMANCE REQUIREMENTS
- 52 A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-
- 53 framed entrance and storefront systems representing those indicated for this Project without failure due to
- 54 defective manufacture, fabrication, installation, or other defects in construction.
- 55 1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure,
- 56 including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly
- 57 distributed and concentrated live loads.
- 58 2. Failure also includes the following:

- 1 a. Thermal stresses transferring to building structure.
- 2 b. Glass breakage.
- 3 c. Noise or vibration created by wind and thermal and structural movements.
- 4 d. Loosening or weakening of fasteners, attachments, and other components.
- 5 e. Failure of operating units.
- 6 B. Structural Loads:
- 7 1. Wind Loads: As indicated on Drawings.
- 8 C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
- 9 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m)
- 10 and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches.
- 11 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less
- 12 than 75 percent of design dimension and that which reduces edge clearance between framing members
- 13 and glazing or other fixed components to less than 1/8 inch.
- 14 D. Structural: Test in accordance with ASTM E330/E330M as follows:
- 15 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance
- 16 doors, do not evidence deflection exceeding specified limits.
- 17 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies,
- 18 including entrance doors and anchorage, do not evidence material failures, structural distress, or
- 19 permanent deformation of main framing members exceeding 0.2 percent of span.
- 20 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- 21 E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
- 22 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when
- 23 tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load
- 24 design pressure, but not less than 6.24 lbf/sq. ft.
- 25 F. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
- 26 1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure
- 27 equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
- 28 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies'
- 29 normally exposed interior surfaces from sources other than condensation. Water leakage does not include
- 30 water controlled by flashing and gutters, or water that is drained to exterior.
- 31 G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
- 32 1. Thermal Transmittance (U-factor):
- 33 a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x
- 34 deg F as determined in accordance with NFRC 100.
- 35 2. Solar Heat-Gain Coefficient (SHGC):
- 36 a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.26 as determined in
- 37 accordance with NFRC 200.
- 38 3. Air Leakage:
- 39 a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a
- 40 static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
- 41 4. Condensation Resistance Factor (CRF):
- 42 a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in
- 43 accordance with AAMA 1503.
- 44 H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
- 45 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- 46 2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS
- 47 A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and
- 48 reinforced as required to support imposed loads.
- 49 1. Exterior Framing Construction: Thermally broken.
- 50 2. Glazing System: Retained mechanically with gaskets on four sides.
- 51 3. Glazing Plane: Center.
- 52 4. Finish: Clear anodic finish.
- 53 5. Fabrication Method: Field-fabricated stick system.
- 54 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- 55 7. Steel Reinforcement: As required by manufacturer.
- 56 B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where
- 57 framing abuts adjacent construction.

- 1 C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims
2 for aligning system components.
- 3 2.4 GLAZING
- 4 A. Glazing: Comply with Section 088000 "Glazing."
5 B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric
6 glazing gaskets, setting blocks, and shims or spacers.
7 C. Glazing Sealants: As recommended by manufacturer.
8 1. Verify sealant has a VOC content of 250 g/L or less.
9 D. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone
10 formulation that is compatible with structural sealant and other system components with which it comes in contact;
11 recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers
12 for this use.
- 13 2.5 MATERIALS
- 14 A. Sheet and Plate: ASTM B209 (ASTM B209M).
15 B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
16 C. Structural Profiles: ASTM B308/B308M.
17 D. Steel Reinforcement:
18 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
19 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
20 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
21 E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-
22 PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation
23 methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable
24 SSPC standard.
- 25 2.6 ACCESSORIES
- 26 A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and
27 accessories compatible with adjacent materials.
28 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural
29 movements, wind loads, or vibration.
30 2. Reinforce members as required to receive fastener threads.
31 B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and
32 installation tolerances in material and finish compatible with adjoining materials and recommended by
33 manufacturer.
34 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with
35 ASTM A123/A123M or ASTM A153/A153M requirements.
36 C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible
37 with adjacent materials.
38 D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm)
39 thickness per coat.
40 E. Rigid PVC filler.
- 41 2.7 FABRICATION
- 42 A. Form or extrude aluminum shapes before finishing.
43 B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove
44 weld spatter and welding oxides from exposed surfaces by descaling or grinding.
45 C. Fabricate components that, when assembled, have the following characteristics:
46 1. Profiles that are sharp, straight, and free of defects or deformations.
47 2. Accurately fitted joints with ends coped or mitered.
48 3. Physical and thermal isolation of glazing from framing members.
49 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required
50 glazing edge clearances.
51 5. Provisions for field replacement of glazing from interior.
52 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
53 D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
54 E. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.
- 55 2.8 ALUMINUM FINISHES
- 56 A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
57

1 PART 3 - EXECUTION

2
3

4 3.1 EXAMINATION

- 5 A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other
6 conditions affecting performance of the Work.
7 B. Proceed with installation only after unsatisfactory conditions have been corrected.

8 3.2 INSTALLATION OF ALUMINUM-FRAMED STOREFRONT SYSTEMS

- 9 A. Comply with manufacturer's written instructions.
10 B. Do not install damaged components.
11 C. Fit joints to produce hairline joints free of burrs and distortion.
12 D. Rigidly secure nonmovement joints.
13 E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to
14 prevent impeding movement of moving joints.
15 F. Seal perimeter and other joints watertight unless otherwise indicated.
16 G. Metal Protection:
17 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact
18 surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive
19 spacers.
20 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact
21 surfaces with bituminous paint.
22 H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to
23 produce weathertight installation.
24 I. Install joint filler behind sealant as recommended by sealant manufacturer.
25 J. Install components plumb and true in alignment with established lines and grades.
26 K. Install glazing as specified in Section 088000 "Glazing."

27 3.3 ERECTION TOLERANCES

- 28 A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:
29 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
30 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
31 3. Alignment:
32 a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide,
33 limit offset from true alignment to 1/16 inch.
34 b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset
35 from true alignment to 1/8 inch.
36 c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset
37 from true alignment to 1/4 inch.
38 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

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END OF SECTION

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**SECTION 08 71 00
 DOOR HARDWARE**

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33	PART 1 – GENERAL		
34			
35	1.1 SUMMARY		
36	A. Section Includes:		
37	1. Commercial door hardware for aluminum entrances, wood and steel doors		
38	2. Coordination and interface with Owner’s Security System.		
39	3. Templates		
40	4. Keying System		
41	1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS		
42	A. Furnish all hardware to Section 06200 for installation.		
43	1.3 RELATED WORK		
44	A. Section 08 11 00 - Metal Doors and Frames: Doors and Frames prepared for finish hardware.		
45	B. Section 08 21 00 - Wood Doors: Wood doors: Doors and Frames prepared for finish hardware.		
46	C. Division 26 - Electrical Power supply to electric hardware devices and low voltage control.		
47	1.4 REFERENCES		
48	A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped		
49	People.		
50	B. ANSI/NFPA 80 - Fire Doors and Windows.		
51	C. BHMA - Builders' Hardware Manufacturers Association.		
52	D. DHI - Door and Hardware Institute.		
53	E. NAAMM - National Association of Architectural Metal Manufacturers.		
54	F. NFPA 101 - Life Safety Code.		
55	G. SDI - Steel Door Institute.		
56	H. ADA - The Americans with Disabilities Act.		

- 1 1.5 COORDINATION
- 2 A. Coordinate work of this Section with other directly affected Sections involving manufacturer of any internal
- 3 reinforcement for hardware.
- 4 B. Furnish template for application to doors and jambs with machine or wood screws or through-bolts as required.
- 5 Templates or hardware or both shall be delivered to factory or building as required by those furnishing items to which
- 6 hardware is to be applied. Refer to other Sections of Specifications for this information. Locksets for metal doors
- 7 shall have beveled faces to correspond with bevel or doors. Strikes shall be ASA Standard dimension. Locks having
- 8 bolts or latches engaging with mullions or jambs of hollow metal shall have box type strikes with curved lips.
- 9 C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to
- 10 power supplies and building safety and security systems.
- 11 D. Cooperate with installing contractor and others with regard to application of hardware. Make occasional inspections
- 12 to verify that items are properly used, installed, in correct location and master-key system is maintained. Report
- 13 improper application of hardware.
- 14 E. Prior to preparing shop drawing submittal, contact Architect to set up a meeting with the Owner to review door
- 15 functions.
- 16 1.6 QUALITY ASSURANCE
- 17 A. Manufacturers: Companies specializing in manufacturing door hardware with minimum three years experience.
- 18 B. Hardware Supplier: Company specializing in supplying commercial and institutional door hardware with five years
- 19 experience.
- 20 C. Each type of hardware shall be furnished from only one manufacturer.
- 21 D. No hardware shall be attached to metal frames with self-tapping or sheet metal screws.
- 22 E. Furnish thru bolts for fastening overhead holders and closers on composite core doors.
- 23 1.7 REGULATORY REQUIREMENTS
- 24 A. Conform to NFPA Standard No. 80 requirements applicable to fire rated doors and frames.
- 25 B. Provide only hardware which has been tested and listed by U.L. for types and sizes of doors required and complies
- 26 with requirements of door and door frame labels.
- 27 1.8 CERTIFICATIONS
- 28 A. Architectural Hardware Vendor shall inspect complete installation and certify that hardware and installation has been
- 29 furnished and installed in accordance with manufacturer's instructions and as specified herein.
- 30 B. Provide two copies of certifications to Architect.
- 31 1.9 SUBMITTALS
- 32 A. Before ordering material, prepare and submit complete vertical hardware schedule for all hardware materials to
- 33 Architect for review. Approval of schedule does not relieve Contractor of any responsibility for furnishing material in
- 34 accordance with requirements of work.
- 35 B. Schedule shall be specific and conclusive with respect to catalog numbers, finishes, template requirements, brackets,
- 36 type of fasteners and locations. Incomplete schedule will not be checked.
- 37 C. Include in schedule, installation dimensions, hardware locations and mounting heights of each type of hardware.
- 38 D. Prepare detailed keying schedule after obtaining Owner's instructions and requirements, and submit for approval.
- 39 E. Samples, if requested shall be submitted to Architect for approval. Approved samples, if of proper finish, will be
- 40 delivered to job for ultimate use; otherwise samples will be returned to Contractor upon completion.
- 41 F. Submit certificate that hardware to be furnished meets or exceed specified requirements.
- 42 G. Submit catalog cut sheets describing all hardware items.
- 43 H. Coordinate with Electrical Contractor and Owner's Security Design Vendor installation requirements for locksets that
- 44 have electric strikes, door position switches and other line or low voltage requirements.
- 45 I. Operation and Maintenance data.
- 46 1.10 OPERATION AND MAINTENANCE DATA
- 47 A. Submit operation and maintenance data for all hardware items provided.
- 48 B. Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative
- 49 maintenance.
- 50 C. Include one copy of final approved hardware and keying schedule.
- 51 1.11 DELIVERY, STORAGE, AND HANDLING
- 52 A. Send duplicate list of hardware in each shipment to Contractor. Original list shall accompany shipment. Hardware
- 53 vendor shall pay shipping and delivery charges.
- 54 B. Deliver hardware to Carpenter (Section 06200) or to respective shops of other Contractors as required. Consult with
- 55 named Contractors and follow their directions regarding manner, sequence and time of delivery and obtain receipt.
- 56 C. Responsibility for safekeeping after delivery rests with trade to whom hardware was delivered.

- 1 D. Hardware shall be sorted and delivered to jobsite plainly marked to correspond with item numbers of vendor's
- 2 approved schedule and be specific as to exact openings and other locations for which items are packaged. Each door
- 3 opening shall receive separate item number on Hardware Schedule.
- 4 E. Plainly mark packages of hardware so that locations of their use may be ascertained without breaking package.
- 5 Where several packages are needed to complete schedule for one location, securely tie together or box.
- 6 F. Pack hardware by building area unless Contractor receiving hardware orders otherwise.
- 7 G. Hardware Supplier shall check all shipments to insure proper accessories and templates.
- 8 H. Deliver hardware only after detailed schedule, keying diagrams, and samples have been approved.
- 9 I. Provide secure lock-up for hardware delivered to the project. Control handling and installation of hardware items
- 10 which are not immediately replaceable so that the completion of the work will not be delayed by hardware losses.

11 1.12 MAINTENANCE MATERIALS

- 12 A. Provide three each special wrenches and tools applicable to each difference or special hardware component.
- 13 B. Provide three each maintenance tools and accessories supplied by hardware component manufacturer.

14 1.13 WARRANTY

- 15 A. Provide manufacturer's standard warranty.

16
17 PART 2 - PRODUCTS

18
19
20 2.1 SOURCE LIMITATIONS

- 21 A. Obtain each type of door hardware from single manufacturer.

22 2.2 PERFORMANCE REQUIREMENTS

- 23 A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80
- 24 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive
- 25 pressure in accordance with NFPA 252 or UL 10C.
- 26 B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for
- 27 intended location and application.
- 28 C. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use
- 29 of a key, tool, or special knowledge for operation.
- 30 D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC A117.1.
- 31 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that
- 32 operate with a force of not more than 5 lbf (22.2 N).
- 33 2. Comply with the following maximum opening-force requirements:
- 34 a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
- 35 b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- 36 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm)
- 37 high.
- 38 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5
- 39 seconds to move to a position of 12 degrees from the latch.
- 40 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to
- 41 move to the closed position.

42 2.3 MATERIALS

- 43 A. Locks, Latches, Cylinders, and Dead Locks
- 44 1. Shall be Schlage ND series and L series as noted in hardware sets. Backset shall be 2-3/4" for all locks, latches
- 45 and dead locks, unless otherwise required to match existing door prep's. No substitutions.
- 46 2. All locks and latches shall be of one manufacturer.
- 47 3. All cylinder cores shall be Best brand cores. No substitutions.
- 48 B. Exit Devices
- 49 1. Devices shall be as manufactured by Von Duprin as noted in hardware sets. No substitutions.
- 50 2. Function shall be as noted in schedule.
- 51 3. Mount exit devices to match mullions at adjacent doors and frames wherever possible.
- 52 C. Butt Hinges
- 53 1. Shall be Best, Hager, or Ives ball bearing, nonrising loose pin, flat button tip, unless specified to the contrary.
- 54 2. Number of butts required:
- 55 a. Doors up to 7' - 4" - 3 butts
- 56 b. Doors 7' - 4" up to 10' - 4 butts
- 57 3. Butt size requirements
- 58 a. Interior doors up to 36" wide 4-1/2 x 4-1/2 standard weight.

- 1 b. Interior doors over 36" wide 4-1/2 x 4-1/2 heavy weight.
- 2 c. Exterior doors 4-1/2 x 4-1/2 heavy weight.
- 3 4. Door butt legend: (unless otherwise noted in Schedule)
- 4 a. Exterior doors and interior doors exposed to garage/wet areas –stainless steel-NRP.
- 5 b. All other doors steel based.
- 6 5. Furnish UL approved butts on labeled doors.
- 7 6. Provide non-removable pins (NRP) on all exterior and lockable outswinging doors.
- 8 7. Continuous Gear Hinges: Hager, Ives, or Select.
- 9 D. Door Closers
- 10 1. Shall be Corbin Russwin LCN 4040XP series unless otherwise specified in hardware groups.
- 11 2. Closers shall have key adjusting device.
- 12 3. Mount to provide maximum opening permitted by building construction or equipment. Note on schedule
- 13 the maximum swing per location for other trades involved in reinforcement or installation.
- 14 4. All door closers shall be similar in design and appearance to those listed in the schedule, so far as possible, of
- 15 one manufacturer. Furnish special arms and applications as indicated in hardware schedule or as dictated by
- 16 structural conditions or local code requirements. Provide appropriate brackets for doors with transoms.
- 17 5. Door closers at labeled fire doors shall bear UL approval. Provide thru-bolts for mineral core doors unless
- 18 otherwise specified in door specifications.
- 19 E. Pushes, Pulls, and Kickplates
- 20 1. Shall be as manufactured by Hager, Ives, Rockwood, or Trimco..
- 21 2. All plates shall be 16 gauge (0.50), beveled sides and with countersunk screw holes at intervals of not over 6"
- 22 on all four sides. Screws shall be stainless steel oval head, finish to match plates.
- 23 F. Stops and Bumpers
- 24 1. Shall be Hager, Ives, Rixson, Rockwood, or Trimco..
- 25 2. Install bumper behind each door.
- 26 3. Overhead stops and holder types as specified in hardware groups.
- 27 4. Apply with expansion shield and machine screws only.
- 28 5. Provide special templates as required for proper coordination of door closers and overhead door holders.
- 29 G. Manual and Automatic flushbolts.
- 30 1. Shall be Hager, Rockwood, or Trimco.
- 31 H. Low Energy Openers
- 32 1. ADA Automatic Openers: Stanley Magic Force, Horton 4000LE or Motion Access Condor Swing as specified in
- 33 hardware groups. Automatic operators are to be included as supply and install. Coordinate installation and
- 34 operation of opener and switches with electrical contractor.
- 35 I. Thresholds, Weatherstripping, Sound Seals
- 36 1. National Guard, Hager, or Pemko.
- 37 J. Door Silencers or Mutes
- 38 1. Furnish three for each pressed steel frame for single doors, two for each pressed steel frame for pairs of
- 39 doors.
- 40 K. Other Materials
- 41 1. Provide other materials not specifically described but required for a complete and proper installation, as
- 42 selected by the Contractor and approved by the Architect.
- 43 2.4 KEYING
- 44 A. Keying is by owner.
- 45 2.5 FABRICATION
- 46 A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using
- 47 manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or
- 48 greater than that of specified door hardware units and ANSI/BHMA A156.18.
- 49 B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood,
- 50 and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application
- 51 intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to
- 52 match surface of door hardware unless otherwise indicated.
- 53 2.6 FINISHES
- 54 A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.
- 55 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
- 56 covering before shipping.
- 57 C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are
- 58 within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable.

1 Variations in appearance of other components are acceptable if they are within the range of approved Samples and
2 are assembled or installed to minimize contrast.
3

4 PART 3 - EXECUTION
5

6
7 3.1 EXAMINATION

- 8 A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances,
9 labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting
10 performance of the Work.
11 B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified
12 door hardware installation.
13 C. Proceed with installation only after unsatisfactory conditions have been corrected.

14 3.2 PREPARATION

- 15 A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with
16 ANSI/SDI A250.6.

17 3.3 INSTALLATION

- 18 A. Mounting Heights: Mount door hardware units at heights **to comply with the following** unless otherwise indicated
19 or required to comply with governing regulations.
20 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
21 2. Custom Steel Doors and Frames: HMMA 831.
22 B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are
23 required to install door hardware onto or into surfaces that are later to be painted or finished in another way,
24 coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install
25 surface-mounted items until finishes have been completed on substrates involved.
26 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary
27 for proper installation and operation.
28 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors
29 in accordance with industry standards.
30 C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number
31 recommended by manufacturer for application indicated or one hinge for every **30 inches (760 mm)** of door height,
32 whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are
33 provided.
34 D. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, **above accessible ceilings or in**
35 **equipment room**. Verify location with Architect.
36 1. Configuration: Provide **one power supply for each door opening or least number of power supplies required**
37 **to adequately serve doors** with electrified door hardware.
38 E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with
39 requirements specified in Section 079200 "Joint Sealants."
40 F. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
41 1. Do not notch perimeter gasketing to install other surface-applied hardware.

42 3.4 INSPECTION AND ADJUSTMENTS

- 43 A. Hardware vendor shall, before substantial completion of project, and/or as directed by Architect, inspect all locks
44 that are part of this project to see that keys pass proper locks as required.
45 B. Check that all locks and latches are properly lubricated, as recommended by manufacturer, with lock lubricant and
46 that all moving parts are adjusted correctly to insure free, smooth operation.
47 C. Door closers and holders shall be checked for proper lubrication. After building is in use, arrange with factory
48 representative of closer manufacturer to make final adjustments to closers to meet building conditions.
49

50 3.5 CLEANING AND PROTECTION

- 51 A. Clean adjacent surfaces soiled by door hardware installation.
52 B. Clean operating items as necessary to restore proper function and finish.
53 C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration
54 at time of Substantial Completion.

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SCHEDULE

Check specified schedule against latest revised plans when making up schedule for approval. Schedule each door separately and, where practical, item numbers shall be same as door numbers and in consecutive sequence.

If hardware is not scheduled for a particular door, furnish hardware of types specified for similar locations as far as practical.

Include accessories required to fully equip in satisfactory manner, doors and the like as shown and specified. Include necessary screws, nuts, bolts, expansion shields and other devices necessary for proper application.]

Items of hardware herein described shall be considered as standard and, unless otherwise specifically mentioned, all hardware used throughout work shall be equal thereto in size, weight, material and workmanship. Revision of standard hardware, which may be necessary to conform to details shall be provided. Items not specifically mentioned but necessary for completion of work shall be of most suitable type matching in quality and finish items which are described.

SET 01

1	EA	CONTINUOUS HINGE	224HD	CLR IVES
1	EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
1	EA	CORE	AS REQUIRED	626 BEST
1	EA	AUTO OPERATOR	MAGIC FORCE	689 STANLEY
2	EA	ACTUATOR	4 ¾" SWITCH	630 STANLEY
1	EA	ELECTRIC STRIKE	6211	630 VON DUPRIN
1	EA	LATCH PROTECTOR	LG14	630 IVES
1	SET	WEATHERSTRIP	160S	AL NGP
1	EA	SWEEP	200N	AL NGP
1	EA	THRESHOLD	8425	AL NGP

**CARD READER/KEYPAD BY SECURITY SUPPLIER.

OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. VALID CARD READ ALSO ACTIVATES OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW AUTOMATIC OPERATOR ENTRY. UPON LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

SET 02

1	EA	CORE	AS REQUIRED	626 BEST
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**BALANCE OF HARDWARE IS EXISTING TO REMAIN.

SET 03

1	EA	PASSAGE	ND70S X SPA	626 SCHLAGE
---	----	---------	-------------	-------------

**BALANCE OF HARDWARE IS EXISTING TO REMAIN.

1 **SET 04**

2	1	EA	CONTINUOUS HINGE	224HD	CLR IVES
3	1	EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
4	1	EA	CORE	AS REQUIRED	626 BEST
5	1	EA	CLOSER	4040XP	689 LCN
6	1	EA	WALL STOP	409	630 ROCKWOOD
7	1	EA	ELECTRIC STRIKE	6211	630 VON DUPRIN

8

9 **CARD READER/KEYPAD BY SECURITY SUPPLIER.

10

11 OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. UPON
12 LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

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15 **SET 05**

16	1	EA	CORE	AS REQUIRED	626 BEST
17	1	EA	ELECTRIC STRIKE	6211	630 VON DUPRIN
18	1	EA	LATCH PROTECTOR	LG14	630 IVES
19	1	SET	WEATHERSTRIP	160S	AL NGP
20	1	EA	SWEEP	200N	AL NGP

21

22 **CARD READER/KEYPAD BY SECURITY SUPPLIER.

23

24 OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. VALID
25 CARD READ ALSO ACTIVATES OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW AUTOMATIC OPERATOR ENTRY.
26 UPON LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

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29 **SET 06**

30	1	EA	CONTINUOUS HINGE	224HD	CLR IVES
31	1	EA	PUSH	70C	630 ROCKWOOD
32	1	EA	PULL	BF111 X 70C	630 ROCKWOOD
33	1	EA	CLOSER	4040XP	689 LCN
34	1	EA	WALL STOP	409	630 ROCKWOOD

35

36

37 **SET 07**

38	1	EA	PUSH	70C	630 ROCKWOOD
39	1	EA	PULL	BF111 X 70C	630 ROCKWOOD

40

41 **BALANCE OF HARDWARE IS EXISTING TO REMAIN.

42

43

44 **SET 08**

45	3	EA	HINGE FILLERS	AS REQUIRED	652 DON-JO
46	1	EA	CONTINUOUS HINGE	157XY	CLR IVES
47	1	EA	KICKPLATE	8" X 2" LDW	630 ROCKWOOD

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1 **SET 09**

2	1	EA	CONTINUOUS HINGE	224HD	CLR IVES
3	1	EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
4	1	EA	CORE	AS REQUIRED	626 BEST
5	1	EA	CLOSER	4040XP X SCUSH	689 LCN
6	1	EA	ELECTRIC STRIKE	6211	630 VON DUPRIN
7	1	EA	LATCH PROTECTOR	LG14	630 IVES
8	1	SET	WEATHERSTRIP	160S	AL NGP
9	1	EA	SWEEP	200N	AL NGP
10	1	EA	THRESHOLD	8425	AL NGP

11

12 ****CARD READER/KEYPAD BY SECURITY SUPPLIER.**

13

14 OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. VALID
15 CARD READ ALSO ACTIVATES OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW AUTOMATIC OPERATOR ENTRY.
16 UPON LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

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18

19 **SET 10**

20		EA	HINGES	AS SPECIFIED	652 IVES
21	1	EA	CLASSROOM LOCK	ND70BD X SPA	626 SCHLAGE
22	1	EA	CORE	AS REQUIRED	626 BEST
23	1	EA	CLOSER	4040XP EDA	689 LCN
24	1	EA	WALL STOP	409	630 ROCKWOOD

25

26

27 **SET 11**

28		EA	HINGES	AS SPECIFIED	652 IVES
29	1	EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
30	1	EA	CORE	AS REQUIRED	626 BEST
31	1	EA	CLOSER	4040XP	689 LCN
32	1	EA	WALL STOP	409	630 ROCKWOOD
33	1	EA	ELECTRIC STRIKE	6211	630 VON DUPRIN

34

35 ****CARD READER/KEYPAD BY SECURITY SUPPLIER.**

36 ****ALLOW 180 DEGREE SWING AT DOOR 290.**

37

38 OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. UPON
39 LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

40

41

42 **SET 12**

43		EA	HINGES	AS SPECIFIED	652 IVES
44	1	EA	PASSAGE	ND10S X SPA	626 SCHLAGE
45	1	EA	CLOSER	4040XP	689 LCN
46	1	EA	WALL STOP	409	630 ROCKWOOD

47

48

49 **SET 13**

50		EA	HINGES	AS SPECIFIED	630 IVES
51	1	EA	EXIT DEVICE	99L-BE-F	626 VON DUPRIN
52	1	EA	CLOSER	4040XP X SCUSH	689 LCN
53	1	SET	SEALS	5050C	BLK NGP

54

55 ****PROVIDE STAINLESS STEEL HINGES**

56

57

58

1 **SET 14**

2	EA	HINGES	AS SPECIFIED	652 IVES
3	1 EA	PUSH	70C	630 ROCKWOOD
4	1 EA	PULL	BF111 X 70C	630 ROCKWOOD
5	1 EA	CLOSER	4040XP	689 LCN
6	1 EA	WALL STOP	409	630 ROCKWOOD
7	1 SET	SEALS	5050C	BLK NGP
8	1 EA	THRESHOLD	896N	AL NGP

9

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11 **SET 15**

12	EA	HINGES	AS SPECIFIED	652 IVES
13	1 EA	CLASSROOM LOCK	ND70BD X SPA	626 SCHLAGE
14	1 EA	CORE	AS REQUIRED	626 BEST
15	1 EA	CLOSER	4040XP-H	689 LCN
16	1 EA	WALL STOP	409	630 ROCKWOOD

17

18

19 **SET 16**

20	EA	HINGES	AS SPECIFIED	652 IVES
21	1 EA	PRIVACY	L9040 X 17A X L283-722	626 SCHLAGE
22	1 EA	OVERHEAD STOP	GJ100 SERIES	630 GLYNN-JOHNSON

23

24

25 **SET 17**

26	EA	HINGES	AS SPECIFIED	652 IVES
27	1 EA	PRIVACY	L9040 X 17A X L283-722	626 SCHLAGE
28	1 EA	CLOSER	4040XP EDA	689 LCN
29	1 EA	WALL STOP	409	630 ROCKWOOD

30

31 **PROVIDE STAINLESS STEEL HINGES AT DOORS 207 AND 208.

32

33

34 **SET 18**

35	EA	HINGES	AS SPECIFIED	652 IVES
36	1 EA	PRIVACY	L9040 X 17A X L283-722	626 SCHLAGE
37	1 EA	WALL STOP	409	630 ROCKWOOD

38

39

40 **SET 19**

41	EA	HINGES	AS SPECIFIED	652 IVES
42	1 EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
43	1 EA	CORE	AS REQUIRED	626 BEST
44	1 EA	CLOSER	4040XP X SCUSH	689 LCN

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1 **SET 20**

2	EA	HINGES	AS SPECIFIED	630 IVES
3	1 EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
4	1 EA	CORE	AS REQUIRED	626 BEST
5	1 EA	CLOSER	4040XP EDA	689 LCN
6	1 EA	WALL STOP	409	630 ROCKWOOD
7	1 EA	ELECTRIC STRIKE	6211	630 VON DUPRIN

8

9 **CARD READER/KEYPAD BY SECURITY SUPPLIER.

10 **PROVIDE STAINLESS STEEL HINGES.

11

12 OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. UPON
13 LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

14

15

16 **SET 21**

17	EA	HINGES	AS SPECIFIED	630 IVES
18	1 EA	ELECTRIC HINGE	AS SPECIFIED X TW8	630 IVES
19	1 EA	DOOR HARNESS	CON-XX	--- SCHLAGE
20	1 EA	HARNESS TO POWER	CON-6W	--- SCHLAGE
21	1 EA	ELECTRIC LOCK	ND80BDEU X SPA	626 SCHLAGE
22	1 EA	CORE	AS REQUIRED	626 BEST
23	2 EA	CLOSER	4040XP EDA	689 LCN
24	2 EA	WALL STOP	409	630 ROCKWOOD
25	1 SET	AUTO FLUSHBOLTS	FB31P	630 IVES
26	1 EA	DUSTPROOF STRIKE	DP2	626 IVES
27	1 EA	COORDINATOR	COR X FL	628 IVES
28	2 EA	MNTG BRACKETS	AS REQUIRED	628 IVES

29

30 **CARD READER/KEYPAD BY SECURITY SUPPLIER.

31 **PROVIDE STAINLESS STEEL HINGES.

32 **ALLOW 180 DEGRE SWING.

33

34 OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ UNLOCKS ELECTRIC LOCK TO ALLOW ENTRY. FREE
35 EGRESS IS ALWAYS ALLOWED.

36

37

38 **SET 22**

39	EA	HINGES	AS SPECIFIED	652 IVES
40	1 EA	OFFICE LOCK	ND53BD X SPA	626 SCHLAGE
41	1 EA	CORE	AS REQUIRED	626 BEST
42	1 EA	WALL STOP	409	630 ROCKWOOD

43

44

45 **SET 23**

46	EA	HINGES	AS SPECIFIED	652 IVES
47	1 EA	PUSH	70C	630 ROCKWOOD
48	1 EA	PULL	BF111 X 70C	630 ROCKWOOD
49	1 EA	CLOSER	4040XP	689 LCN
50	1 EA	WALL STOP	409	630 ROCKWOOD

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1 **SET 24**

2	EA	HINGES	AS SPECIFIED	652 IVES
3	1 EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
4	1 EA	CORE	AS REQUIRED	626 BEST
5	2 EA	CLOSER	4040XP	689 LCN
6	1 EA	WALL STOP	409	630 ROCKWOOD
7	1 EA	OVERHEAD STOP	GJ100 SERIES	630 GLYNN-JOHNSON
8	1 SET	AUTO FLUSHBOLTS	FB31P	630 IVES
9	1 EA	DUSTPROOF STRIKE	DP2	626 IVES
10	1 EA	COORDINATOR	COR X FL	628 IVES

11

12 ****PROVIDE LCN SPECIAL TEMPLATE ST1630 AND 4040XP-18TJ PLATE AS REQUIRED FOR CLOSER AND OVERHEAD STOP**
13 **INSTALLATION.**

14

15

16 **SET 25**

17	1 EA	CONTINUOUS HINGE	224HD	CLR IVES
18	1 EA	PUSH	70C	630 ROCKWOOD
19	1 EA	PULL	BF111 X 70C	630 ROCKWOOD
20	1 EA	CLOSER	4040XP X SCUSH	689 LCN

21

22

23 **SET 26**

24	EA	HINGES	AS SPECIFIED	652 IVES
25	1 EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
26	1 EA	CORE	AS REQUIRED	626 BEST
27	1 EA	CLOSER	4040XP	689 LCN
28	1 EA	WALL STOP	409	630 ROCKWOOD

29

30

31 **SET 27**

32	1 EA	CONTINUOUS HINGE	224HD	CLR IVES
33	1 EA	PUSH	70C	630 ROCKWOOD
34	1 EA	PULL	BF111 X 70C	630 ROCKWOOD
35	1 EA	CLOSER	4040XP	689 LCN
36	1 EA	WALL STOP	409	630 ROCKWOOD
37	1 SET	WEATHERSTRIP	160S	AL NGP
38	1 EA	SWEEP	200N	AL NGP
39	1 EA	THRESHOLD	424	AL NGP

40

41

42 **SET 28**

43 **HARDWARE EXISTING TO REMAIN**

44

45

46 **SET 29**

47	1 EA	ELECTRIC STRIKE	6211	630 VON DUPRIN
48	1 EA	LATCH PROTECTOR	LG14	630 IVES
49	1 SET	WEATHERSTRIP	160S	AL NGP
50	1 EA	SWEEP	200N	AL NGP

51

52 ****CARD READER/KEYPAD BY SECURITY SUPPLIER.**

53

54 **OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. VALID**
55 **CARD READ ALSO ACTIVATES OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW AUTOMATIC OPERATOR ENTRY.**
56 **UPON LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.**

57

58

1	SET 30				
2	EA	HINGES	AS SPECIFIED	652 IVES	
3	1 EA	PRIVACY	L9040 X 17A X L283-722	626 SCHLAGE	
4	1 EA	WALL STOP	409	630 ROCKWOOD	
5	1 SET	SEALS	5050C	BLK NGP	
6	1 EA	AUTO DR BOTTOM	320N	AL NGP	
7	1 EA	THRESHOLD	411	AL NGP	

8
9 **INCLUDE 423N AUTO DOOR BOTTOM AT WOOD DOORS.

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12	SET 31				
13	1 EA	STOREROOM LOCK	L9080B X 17N	626 SCHLAGE	
14	1 EA	CORE	AS REQUIRED	626 BEST	
15	1 EA	ELECTRIC STRIKE	6211	630 VON DUPRIN	
16	1 EA	LATCH PROTECTOR	LG14	630 IVES	
17	1 SET	WEATHERSTRIP	160S	AL NGP	
18	1 EA	SWEEP	200N	AL NGP	

19
20 **CARD READER/KEYPAD BY SECURITY SUPPLIER.
21 **BALANCE OF HARDWARE EXISTING TO REMAIN.

22
23 OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. VALID
24 CARD READ ALSO ACTIVATES OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW AUTOMATIC OPERATOR ENTRY.
25 UPON LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

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28	SET 32				
29	1 EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE	
30	1 EA	CORE	AS REQUIRED	626 BEST	
31	1 EA	CLOSER	4040XP	689 LCN	
32	1 EA	ELECTRIC STRIKE	6211	630 VON DUPRIN	

33
34 **CARD READER/KEYPAD BY SECURITY SUPPLIER.
35 **BALANCE OF HARDWARE EXISTING TO REMAIN.
36 **INSTALL CLOSER WITH RIVNUTS.

37
38 OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. VALID
39 CARD READ ALSO ACTIVATES OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW AUTOMATIC OPERATOR ENTRY.
40 UPON LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

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43	SET 33				
44	EA	HINGES	AS SPECIFIED	630 IVES	
45	1 EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE	
46	1 EA	CORE	AS REQUIRED	626 BEST	
47	1 EA	CLOSER	4040XP X SCUSH	689 LCN	

48
49 **PROVIDE STAINLESS STEEL HINGES.

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1 **SET 34**

2	EA	HINGES	AS SPECIFIED	630 IVES
3	1 EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
4	1 EA	CORE	AS REQUIRED	626 BEST
5	2 EA	CLOSER	4040XP X SHCUSH	689 LCN
6	1 SET	AUTO FLUSHBOLTS	FB31P	630 IVES
7	1 EA	DUSTPROOF STRIKE	DP2	626 IVES
8	1 EA	COORDINATOR	COR X FL	628 IVES
9	2 EA	MNTG BRACKETS	AS REQUIRED	628 IVES
10	1 SET	SEALS	5050C	BLK NGP
11	1 EA	ASTRAGAL	BY DOOR SUPPLIER	
12	2 EA	SWEEP	200N	AL NGP
13	1 EA	THRESHOLD	424 X SIA	AL NGP

14
15

16 **PROVIDE STAINLESS STEEL HINGES.

17
18

19 **SET 35**

20	1 EA	OFFICE LOCK	ND53BD X SPA	626 SCHLAGE
21	1 EA	CORE	AS REQUIRED	626 BEST

22
23

**BALANCE OF HARDWARE IS EXISTING TO REMAIN.

24
25

26 **SET 36**

27	1 EA	STOREROOM LOCK	ND80BD X SPA	626 SCHLAGE
28	1 EA	CORE	AS REQUIRED	626 BEST
29	1 EA	ELECTRIC STRIKE	6211	630 VON DUPRIN

30
31

**CARD READER/KEYPAD BY SECURITY SUPPLIER.

32
33

**BALANCE OF HARDWARE EXISTING TO REMAIN.

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OPERATION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ RELEASES ELECTRIC STRIKE TO ALLOW ENTRY. VALID CARD READ ALSO ACTIVATES OUTSIDE AUTOMATIC OPERATOR ACTUATOR TO ALLOW AUTOMATIC OPERATOR ENTRY. UPON LOSS OF POWER, ELECTRIC STRIKE TO REMAIN SECURED (FAIL SECURE). FREE EGRESS IS ALWAYS ALLOWED.

END OF SECTION

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 GLAZING**

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32	3.8 CLEANING AND PROTECTION.....		7
33			
34	PART 1 – GENERAL		
35			
36	1.1 SUMMARY		
37	A. Section Includes:		
38	1. Windows.		
39	2. Doors.		
40	3. Storefront framing.		
41	4. Interior borrowed lites.		
42	5. Frameless interior pass-thru sliding service window		
43	B. Related Sections:		
44	1. Division 08 Section "Mirrors.		
45	1.2 DEFINITIONS		
46	A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.		
47			
48	B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.		
49	C. Interspace: Space between lites of an insulating-glass unit.		
50	1.3 PERFORMANCE REQUIREMENTS		
51	A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.		
52			
53			
54			
55	B. Glass Design: Glass thicknesses indicated on the Drawings are for detailing only. Design glass to comply with ASTM E 1300 and International Building Code (IBC) according to the following requirements:		
56	1. Design Wind Pressures: As indicated on Drawings.		
57			

- 1 2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind
- 2 pressure based on glass type factors for short duration load.
- 3 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center of-glass deflection at design
- 4 wind pressure to not more than 1/50 times the short side length or 1 inch, whichever is less.
- 5 4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual
- 6 glass lites.
- 7 C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on
- 8 glass framing members and glazing components.
- 9 1. Temperature Change: **120 deg F**, ambient; **180 deg F**, material surfaces.
- 10 D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on
- 11 manufacturer's published test data, as determined according to procedures indicated below:
- 12 1. For monolithic-glass lites, properties are based on units with lites ¼ inch thick.
- 13 2. For insulating-glass units, properties are based on units with lites ¼ inch thick and a nominal ½-inch-wide
- 14 interspace.
- 15 3. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following
- 16 methodologies:
- 17 a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
- 18 b. Solar Heat Gain Coefficient: NFRC 200.
- 19 c. Solar Optical Properties: NFRC 300.
- 20 1.4 SUBMITTALS
- 21 A. Product Data: For each glass product and glazing material indicated.
- 22 B. Glass Samples: For each type of glass product other than clear monolithic vision glass; **12 inches** square.
- 23 C. Glazing accessory samples: For gaskets, sealants, and colored spacers, in 12 inch lengths.
- 24 D. Glazing Schedule: List glass types and thicknesses.
- 25 E. Product Certificates: For glass and glazing products, from manufacturer.
- 26 F. Warranties: Sample of special warranties.
- 27 1.5 QUALITY ASSURANCE
- 28 A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-
- 29 glass manufacturer who is approved by coated-glass manufacturer.
- 30 B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the
- 31 National Glass Association's Certified Glass Installer Program.
- 32 C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the
- 33 NFRC CAP 1 Certification Agency Program.
- 34 D. Source Limitations for Glass: Obtain glazing from single source from single manufacturer for each glass type.
- 35 E. Source Limitations for Glazing Accessories: Obtain glazing from single source from single manufacturer for each
- 36 product and installation method.
- 37 F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations
- 38 below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not
- 39 otherwise defined in this Section or in referenced standards.
- 40 1. GANA Publications: GANA's "Glazing Manual."
- 41 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed
- 42 Insulating Glass Units for Commercial and Residential Use."
- 43 G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label
- 44 of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label
- 45 shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- 46 Provide glazing that complies with 16 CFR 1201, Category II.
- 47 H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of
- 48 units with appropriate certification label of IGCC.
- 49 1.6 DELIVERY, STORAGE, AND HANDLING
- 50 A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing
- 51 materials from condensation, temperature changes, direct exposure to sun, or other causes.
- 52 1.7 PROJECT CONDITIONS
- 53 A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are
- 54 outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain,
- 55 frost, condensation, or other causes.
- 56 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits
- 57 permitted by sealant manufacturer or below **40 deg F**.

- 1 1.8 WARRANTY
- 2 A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass
- 3 manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration
- 4 of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to
- 5 maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling,
- 6 cracking, and other indications of deterioration in coating.
- 7 1. Warranty Period: 10 years from date of Substantial Completion.
- 8 B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass
- 9 manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period.
- 10 Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to
- 11 glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions.
- 12 Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- 13 1. Warranty Period: 10 years from date of Substantial Completion.
- 14 PART 2 - PRODUCTS
- 15
- 16
- 17 2.1 GLASS PRODUCTS, GENERAL
- 18 A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to
- 19 comply with requirements indicated.
- 20 1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
- 21 B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT
- 22 heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened
- 23 glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply
- 24 with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated
- 25 float glass.
- 26 C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in
- 27 manufacturer's published test data, based on procedures indicated below:
- 28 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
- 29 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each
- 30 lite.
- 31 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer
- 32 program, expressed as **Btu/sq. ft. x h x deg F**.
- 33 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and
- 34 based on LBL's WINDOW 5.2 computer program.
- 35 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.
- 36 2.2 GLASS PRODUCTS
- 37 A. Clear Annealed Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- 38 B. Heat-Treated Float Glass: ASTM C 1048; Kind HS, Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of
- 39 kind and condition indicated.
- 40 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge
- 41 of glass as installed unless otherwise indicated.
- 42 2. For uncoated glass, comply with requirements for Condition A.
- 43 3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- 44 C. Fully Tempered Float Glass: ASTM C 1048; Kind FT, Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of
- 45 kind and condition indicated.
- 46 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge
- 47 of glass as installed unless otherwise indicated.
- 48 2. For uncoated glass, comply with requirements for Condition A.
- 49 3. For coated vision glass, comply with requirements for Condition C (other coated glass)
- 50 2.3 INSULATING GLASS
- 51 A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be
- 52 incorporated into the Work include, but are not limited to, the following:
- 53 1. Cardinal Glass
- 54 2. Oldcastle Glass
- 55 3. Guardian Industries
- 56 4. Pilkington
- 57 5. PPG Industries
- 58 6. Visteon Float Glass

- 1 B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated
- 2 interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
- 3 1. Sealing System: Dual seal, with polyisobutylene (primary) and silicone (secondary).
- 4 2. Spacer: "warm edge", non-metallic spacer.
- 5 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- 6 C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-
- 7 Glass Types" Article.
- 8 2.4 GLAZING GASKET
- 9 A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight
- 10 seal, made from one of the following:
- 11 1. EPDM complying with ASTM C 864.
- 12 2. Silicone complying with ASTM C 1115.
- 13 3. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- 14 B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM, silicone or thermoplastic
- 15 polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain
- 16 watertight seal.
- 17 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression
- 18 gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side
- 19 of glazing.
- 20 C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner
- 21 units and zipper lock-strips, complying with ASTM C 542, black.
- 22 2.5 GLAZING SEALANTS
- 23 A. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will
- 24 contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of
- 25 service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- 26 1. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants
- 27 suitable for applications indicated and for conditions existing at time of installation.
- 28 2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- 29 B. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and
- 30 labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings
- 31 indicated.
- 32 2.6 GLAZING TAPES
- 33 A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and
- 34 nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape
- 35 and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products
- 36 indicated below:
- 37 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- 38 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- 39 B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and
- 40 complying with AAMA 800 for the following types:
- 41 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
- 42 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid
- 43 sealant.
- 44 2.7 PASS WINDOWS
- 45 A. Pass Window Units: Factory fabricated, glazed unit; horizontal sliding type.
- 46 B. Header: Extruded aluminum.
- 47 C. Glass: Safety type specified in Section 08 80 00, GLAZING.
- 48 D. Hardware: Manufacturer's standard double track header, rollers, guides, push button lock.
- 49 E. Header: Shall be constructed of 6063-T5 extruded aluminum. Window rolls on top-hung ball bearing rollers. Overall
- 50 size is to be in accordance with the contract drawings.
- 51 F. Finish: All aluminum to be clear, satin anodized.
- 52 G. Glazing: The glazing is to be 6 mm in thickness.
- 53 2.8 MISCELLANEOUS GLAZING MATERIALS
- 54 A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements
- 55 of manufacturers of glass and other glazing materials for application indicated, and with a proven record of
- 56 compatibility with surfaces contacted in installation.
- 57 B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- 58 C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

- 1 D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass
2 lites in place for installation indicated.
- 3 E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- 4 F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing
5 sealant depth and otherwise produce optimum glazing sealant performance.
- 6 G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled
7 fire-resistant glazing product with which it is used for application and fire-protection rating indicated.
- 8 H. U-channel for wet glazed art glass: Deep top channel (1-inch or as indicated) with shallow bottom channel (1/2-inch
9 or as indicated) allowing for 'lift and drop' method of glazing. Width to accommodate thickness of art glass.
- 10 I. Marker Board Standoff:
11 1. 1-inch diameter, satin chrome standoff with matching cap, vinyl washer, and vinyl washer with sleeve.
12 2. 1-inch barrel with standard 1/2-inch cap.
- 13 2.9 FABRICATION OF GLAZING UNITS
- 14 A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge
15 and surface conditions, and bite complying with written instructions of product manufacturer and referenced
16 glazing publications, to comply with system performance requirements.
- 17 B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at
18 junctions of edges and faces.
- 19 C. Grind smooth and polish exposed glass edges and corners.
- 20 2.10 MONOLITHIC-GLASS TYPES
- 21 A. Glass Type GL-3: Clear annealed float glass.
22 1. Thickness: 6.0 mm.
- 23 B. Glass Type GL-4: Clear fully tempered float glass.
24 1. Thickness: 6.0 mm or 9.5 mm as noted.
25 2. Provide safety glazing labeling.
- 26 C. INSULATING-GLASS TYPES
- 27 1. Glass Type GL-1: Low-E coated, Clear insulating glass.
28 a. Overall Unit Thickness: 1 inch.
29 b. Thickness of Each Glass Lite: 6.0 mm.
30 c. Outdoor Lite: Clear Float glass.
31 d. Interspace Content: Air.
32 e. Indoor Lite: Clear Float glass.
33 f. Low-E Coating: Sputtered on second surface.
34 g. Visible Light Transmittance: 63 percent minimum.
35 h. Center of Glass U-Value: 0.29Btu/hr maximum.
36 i. Solar Heat Gain Coefficient (SHGC): 0.27 maximum
- 37 2. Glass Type GL-2: Low-E coated, Clear insulating glass.
38 a. Overall Unit Thickness: 1 inch.
39 b. Thickness of Each Glass Lite: 6.0 mm.
40 c. Outdoor Lite: Fully tempered float glass.
41 d. Interspace Content: Air.
42 e. Indoor Lite: Fully tempered float glass.
43 f. Low-E Coating: Sputtered on second surface.
44 g. Visible Light Transmittance: 63 percent minimum.
45 h. Center of Glass U-Value: 0.29Btu/hr maximum.
46 i. Solar Heat Gain Coefficient (SHGC): 0.27 maximum
47 j. Provide safety glazing labeling.
- 48 3. Glass Type GL-5: Bird Glass Pattern applied to GL-1 or GL-2 where indicated.
49 a. Bird Glass Coating: Similar to Viracon 51767 Bird Friendly.
50 b. Coverage: 1% ; 1/4" dots, 2x2 staggered.
51 c. Color: V952 Warm Gray.
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1 PART 3 - EXECUTION

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4 3.1 EXAMINATION

- 5 A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
- 6 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 7 2. Presence and functioning of weep systems.
 - 8 3. Minimum required face and edge clearances.
 - 9 4. Effective sealing between joints of glass-framing members.
- 10 B. Proceed with installation only after unsatisfactory conditions have been corrected.

11 3.2 PREPARATION

- 12 A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings
13 not firmly bonded to substrates.
- 14 B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and
15 interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

16 3.3 GLAZING, GENERAL

- 17 A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials,
18 unless more stringent requirements are indicated, including those in referenced glazing publications.
- 19 B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on
20 glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- 21 C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and
22 legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when
23 installed, could weaken glass and impair performance and appearance.
- 24 D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- 25 E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless
26 otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- 27 F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- 28 G. Provide spacers for glass lites where length plus width is larger than **50 inches**.
- 29 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size
30 and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have
31 demonstrated ability to maintain required face clearances and to comply with system performance
32 requirements.
 - 33 2. Provide **1/8-inch** minimum bite of spacers on glass and use thickness equal to sealant width. With glazing
34 tape, use thickness slightly less than final compressed thickness of tape.
- 35 H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as
36 recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- 37 I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- 38 J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- 39 K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side,
40 provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- 41 L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer
42 to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket
43 manufacturer.
- 44 3.4 TAPE GLAZING
- 45 A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude
46 slightly above sightline of stops.
- 47 B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit
48 opening.
- 49 C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing
50 joints by applying tapes to jambs and then to heads and sills.
- 51 D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes
52 with compatible sealant approved by tape manufacturer.
- 53 E. Do not remove release paper from tape until right before each glazing unit is installed.
- 54 F. Apply heel bead of elastomeric sealant as required.
- 55 G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets
56 formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and
57 work toward centers of openings.
- 58 H. Apply cap bead of elastomeric sealant over exposed edge of tape.

- 1 3.5 GASKET GLAZING (DRY)
- 2 A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance
- 3 for stretch during installation.
- 4 B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut
- 5 and bonded together at corners.
- 6 C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against
- 7 soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces
- 8 of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets
- 9 to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant
- 10 recommended by gasket manufacturer.
- 11 D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against
- 12 soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly
- 13 to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in
- 14 glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- 15 E. Install gaskets so they protrude past face of glazing stops.
- 16 3.6 SEALANT GLAZING (WET)
- 17 A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing
- 18 stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep
- 19 systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of
- 20 installed sealant relative to edge clearance for optimum sealant performance.
- 21 B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass
- 22 and channel surfaces.
- 23 C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- 24 3.7 LOCK-STRIP GASKET GLAZING
- 25 A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and
- 26 weep system unless otherwise indicated.
- 27 3.8 CLEANING AND PROTECTION
- 28 A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held
- 29 away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- 30 B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such
- 31 protection, contaminating substances do come into contact with glass, remove substances immediately as
- 32 recommended in writing by glass manufacturer.
- 33 C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals
- 34 during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove
- 35 as recommended in writing by glass manufacturer.
- 36 D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes,
- 37 accidents, and vandalism, during construction period.
- 38 E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for
- 39 inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass
- 40 manufacturer.
- 41
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END OF SECTION

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SECTION 08 83 00
MIRRORS

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21 PART 1 – GENERAL
22
23 1.1 SUMMARY
24 A. Section Includes:
25 1. Silvered flat glass mirrors.
26 B. Related Requirements:
27 1. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.
28 1.2 SUBMITTALS
29 A. Product Data: For each type of product.
30 1. Mirrors: Include description of materials and process used to produce each type of silvered flat glass mirror
31 specified that indicates sources of glass, glass coating components, edge sealer, and quality-control
32 provisions.
33 B. Sustainable Design Submittals:
34 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
35 2. Verify adhesives have a VOC content of **70 g/L** or less.
36 3. Product Data: For adhesives, indicating VOC content.
37 4. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting
38 materials.
39 C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.
40 D. Product Certificates: For each type of mirror **and mirror mastic**.
41 E. Sample Warranty: For special warranty.
42 F. Maintenance Data: For mirrors to include in maintenance manuals.
43 1.3 DELIVERY, STORAGE, AND HANDLING
44 A. Protect mirrors in accordance with mirror manufacturer's written instructions and as needed to prevent damage to
45 mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
46 B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to
47 prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store
48 indoors.
49 1.4 FIELD CONDITIONS
50 A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are
51 maintained at levels indicated for final occupancy.
52 1.5 WARRANTY
53 A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period.
54 Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage
55 or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include
56 discoloration, black spots, and clouding of the silver film.
57 1. Warranty Period: **Five** years.
58

1 PART 2 - PRODUCTS

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4 2.1 SOURCE LIMITATIONS

- 5 A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
6 B. Source Limitations for Mirror Accessories: Obtain mirror-glazing accessories from single source.

7 2.2 SILVERED FLAT GLASS MIRRORS

- 8 A. Mirrors, General: ASTM C1503.
9 B. Annealed Monolithic Glass Mirrors: Mirror **Glazing** Quality, **clear**.
10 1. Nominal Thickness: **3.0 mm**.

11 2.3 MISCELLANEOUS MATERIALS

- 12 A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
13 B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting
14 against silver deterioration at mirrored glass edges.
15 C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified
16 by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be
17 installed.

18 2.4 FABRICATION

- 19 A. Shop fabricate mirrors to greatest extent possible.
20 B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they
21 fit closely around penetrations in mirrors.
22 C. Mirror Edge Treatment: **Flat polished**.
23 1. Seal edges of mirrors with edger after edge treatment to prevent chemical or atmospheric penetration of
24 glass coating.

25
26

26 PART 3 - EXECUTION

27
28

29 3.1 EXAMINATION

- 30 A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation
31 tolerances, substrate preparation, and other conditions affecting performance of the Work.
32 B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with
33 mirror mastic.
34 C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

35 3.2 PREPARATION

- 36 A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating
37 substrates with mastic manufacturer's special bond coating where applicable.

38 3.3 INSTALLATION

- 39 A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National
40 Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected
41 images.
42 1. NGA Publications: "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass
43 Mirrors."
44 B. Provide a minimum airspace of **1/8 inch (3 mm)** between back of mirrors and mounting surface for air circulation
45 between back of mirrors and face of mounting surface.
46 C. Install mirrors with **mastic**. Attach mirror hardware securely to mounting surfaces.
47 1. Install mastic as follows:
48 a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and
49 backing material.
50 b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow
51 air circulation between back of mirrors and face of mounting surface.
52 c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of
53 **1/8 inch (3 mm)** between back of mirrors and mounting surface.

54 3.4 CLEANING AND PROTECTION

- 55 A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
56 B. Do not permit edges of mirrors to be exposed to standing water.
57 C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or
58 other sources for continuous periods of time.

- 1 D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date
- 2 of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication
- 3 "Proper Procedures for Cleaning Flat Glass Mirrors."
- 4
- 5
- 6

END OF SECTION

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**SECTION 09 01 90
 MAINTENANCE REPAINTING**

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 27 PART 1 – GENERAL
 28
 29 1.1 SUMMARY
 30 A. Section includes maintenance repainting as follows:
 31 1. Removing existing paint.
 32 2. Patching substrates
 33 B. Related Requirements:
 34 1. Section 09 91 13 "Exterior Painting"
 35 2. Section 09 91 23 "Interior Painting" for Paint materials and systems.
 36 1.2 DEFINITIONS
 37 A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
 38 B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
 39 1.3 PREINSTALLATION MEETINGS
 40 A. Preinstallation Conference: Conduct conference at Project site.
 41 1.4 SEQUENCING AND SCHEDULING
 42 A. Perform maintenance repainting in the following sequence, which includes work specified in this and other
 43 Sections:
 44 1. Dismantle existing surface-mounted objects and hardware except items indicated to remain in place. Tag
 45 items with location identification and protect.
 46 2. Verify that temporary protections have been installed.
 47 3. Examine condition of surfaces to be painted.
 48 4. Remove existing paint to the degree required for each substrate and surface condition of existing paint.
 49 5. Apply paint system.
 50 6. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.
 51 1.5 SUBMITTALS
 52 A. Product Data: For each type of product.
 53 1. Include recommendations for product application and use.
 54 2. Include test data substantiating that products comply with requirements.
 55 B. Product List: For each paint product indicated, include the following:
 56 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on
 57 Drawings and in schedules.

- 1 2. Printout of current "MPI Approved Products List" for each MPI-product category specified in paint systems,
- 2 with the proposed product highlighted.
- 3 3. VOC content.
- 4 1.6 QUALITY ASSURANCE
- 5 A. A. Mockups: Prepare mockups of maintenance repainting processes for each type of coating system and substrate
- 6 indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for
- 7 materials and execution. Duplicate appearance of approved Sample submittals.
- 8 1. Locate mockups on existing surfaces where directed by Architect.
- 9 2. Surface-Preparation Mockups: On existing surfaces using applicable specified methods of cleaning and other
- 10 surface preparation, provide mockup sample of at least 10 sq. ft.
- 11 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
- 12 mockups unless Architect specifically approves such deviations in writing.
- 13 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if
- 14 undisturbed at time of Substantial Completion.
- 15 1.7 PRECONSTRUCTION TESTING
- 16 A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing of cleaning
- 17 materials, paint removers and compatibility of paint coatings and systems for each type of painted surface.
- 18 1. Use test areas as indicated and representative of proposed materials and existing construction.
- 19 2. Propose changes to materials and methods to suit Project.
- 20 1.8 DELIVERY, STORAGE, AND HANDLING
- 21 A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures
- 22 continuously maintained at not less than 45 deg F (7 deg C).
- 23 1. Maintain containers in clean condition, free of foreign materials and residue.
- 24 2. Remove rags and waste daily.
- 25 1.9 FIELD CONDITIONS
- 26 A. Weather Limitations: Proceed with maintenance repainting only when existing and forecasted weather conditions
- 27 are within the environmental limits set by each manufacturer's written instructions and specified requirements.
- 28
- 29 PART 2 - PRODUCTS
- 30
- 31
- 32 2.1 PREPARATORY CLEANING MATERIALS
- 33 A. Water: Potable.
- 34 B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).
- 35 C. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125
- 36 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15
- 37 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.
- 38 D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of
- 39 household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts
- 40 (3 L) of warm water.
- 41 E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and
- 42 steel-wire brushes of various sizes.
- 43 F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for
- 44 removing corrosion from iron and steel.
- 45 G. High Pressure Cryogenic Liquid-Nitrogen Jet Cleaning: for surface ablation and cleaning.
- 46 2.2 PATCHING MATERIALS
- 47 A. Metal-Patching Compound: Two-part, polyester-resin, metal-patching compound; knife grade formulation as
- 48 recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of
- 49 work, and site conditions. Compound shall be produced for filling metal that has deteriorated from corrosion. Filler
- 50 shall be capable of filling deep holes and spreading to feather edge.
- 51 B. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically
- 52 manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as
- 53 recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and
- 54 traffic, the detail of work, and site conditions.
- 55 C. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C842 and
- 56 manufacturer's written instructions.
- 57

1 PART 3 - EXECUTION

2
3
4 3.1 PROTECTION

- 5 A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage
6 from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles,
7 landscaping, buildings, and other surfaces that could be harmed by such contact.
- 8 1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless the
9 solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof.
10 Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking
11 agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent
12 adhesive staining.
 - 13 2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
 - 14 3. Neutralize and collect alkaline and acid wastes before disposal.
 - 15 4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining
16 of paving and foundations, damage to landscaping, and water penetration into building interiors.

17 3.2 MAINTENANCE REPAINTING, GENERAL

- 18 A. Maintenance Repainting Appearance Standard: Completed work is to have a uniform appearance as viewed by
19 Architect from the building at 15 feet away from painted surface.
- 20 B. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:
- 21 1. Remove failed coatings and corrosion and repaint.
 - 22 2. Verify that substrate surface conditions are suitable for repainting.
 - 23 3. Allow other trades to repair items in place before repainting.
- 24 C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and
25 lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.
- 26 D. Heat Processes: Do not use torches, heat guns, or heat plates.

27 3.3 EXAMINATION

- 28 A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture
29 content and other conditions affecting performance of painting work. Comply with paint manufacturer's written
30 instructions for inspection.
- 31 B. Maximum Moisture Content of Substrates: Do not begin application of coatings unless moisture content of exposed
32 surface is below the maximum value recommended in writing by paint manufacturer and not greater than the
33 following maximum values when measured with an electronic moisture meter appropriate to the substrate
34 material:
- 35 1. Concrete: 12 percent.
 - 36 2. Gypsum Board: 12 percent.
 - 37 3. Masonry (Clay and CMU): 12 percent.
- 38 C. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by
39 paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry
40 surfaces.
- 41 D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- 42 1. If existing surfaces cannot be prepared to an acceptable condition for proper finishing by using specified
43 surface-preparation methods, notify Architect in writing.
- 44 E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
- 45 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

46 3.4 PREPARATORY CLEANING

- 47 A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all
48 surfaces, corners, contours, and interstices.
- 49 B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with
50 detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small
51 brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent
52 is used and that surface remains wet. Rinse with water applied by clean rags or sponges.
- 53 C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted
54 surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary,
55 spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is
56 allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign
57 materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

- 1 D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by
2 scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with
3 water applied by clean rags or sponges.
- 4 E. Chemical Rust Removal:
5 1. Remove loose rust scale with specified abrasives for ferrous-metal cleaning.
6 2. Apply rust remover with brushes or as recommended in writing by manufacturer.
7 3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as
8 determined by preconstruction testing. Do not allow extended dwell time
9 4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended
10 in writing by manufacturer to remove residue.
11 5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
12 6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.
- 13 F. Mechanical Rust Removal:
14 1. Remove rust with specified abrasives for ferrous-metal cleaning. Clean to bright metal.
15 2. Wipe off residue with mineral spirits and either steel wool or soft rags.
16 3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
17 4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.
- 18 G. High Pressure Cryogenic Liquid-Nitrogen Jet Cleaning: for surface ablation and cleaning.
19 1. The treatment consists in impacting the surface with a high pressure (up to 3500 bar) cryogenic nitrogen jet
20 (down to -160°C).
21 2. The pressurized cryogenic nitrogen exits from a nozzle - having generally a 0.2 to 0.5 mm diameter outlet -
22 to form the high velocity (supersonic) nitrogen jet.
- 23 3.5 PAINT REMOVAL
- 24 A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the
25 paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required
26 by conditions.
27 1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not
28 allow paint removers to remain on surface for periods longer than those indicated or recommended in
29 writing by manufacturer.
30 a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final
31 appearance without streaks.
32 b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.
33 2. Brushes: Use brushes that are resistant to chemicals being used.
34 a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal
35 being treated.
36 b. Wood Substrates: Do not use wire brushes.
37 3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure
38 indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage
39 surfaces.
40 a. Equip units with pressure gages.
41 b. Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface and apply
42 material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce
43 uniform coverage.
44 c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical
45 indicated, equipped with nozzle having a coneshaped spray.
46 d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50
47 degrees.
48 e. For heated water-spray application, use equipment capable of maintaining temperature between
49 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.
- 50 B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and
51 metallic wool as appropriate for the substrate material.
- 52 3.6 SUBSTRATE REPAIR
- 53 A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials
54 and finishes.
- 55 B. Cementitious Material Substrate:
56 1. General: Repair defects including dents and chips more than 1/4 inch (6 mm) in size and all holes and cracks
57 by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.

- 1 2. New and Bare Plaster: Neutralize surface of plaster with mild acid solution as recommended in writing by
2 paint manufacturer. In lieu of acid neutralization, follow manufacturer's written instruction for primer or
3 transition coat over alkaline plaster surfaces.
- 4 3. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt,
5 grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.
- 6 C. Gypsum-Plaster and Gypsum-Board Substrates:
7 1. Repair defects including dents and chips more than 1/8 inch (3 mm) in size and all holes and cracks by filling
8 with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
- 9 2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.
- 10 D. Metal Substrate:
11 1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use chemical or mechanical rust
12 removal method to clean off rust.
- 13 2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and
14 gouges more than 1/16 inch (6 mm) deep or 1/2 inch (13 mm) across and all holes and cracks by filling with
15 metal-patching compound and sanding smooth. Remove burrs and protruding fasteners.
- 16 3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners,
17 crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of
18 the Work.
- 19 3.7 FIELD QUALITY CONTROL
20 A. Manufacturer's Field Service: Engage paint-remover manufacturer's factory-authorized service representative for
21 consultation and Project-site inspection and to provide on-site assistance when requested by Architect.
- 22 B. Paint Material Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and
23 test paint for composition and dry film thickness.
24 1. Paint Composition: The following procedure may be performed at any time and as often as Owner deems
25 necessary during the period when paints are being applied:
26 a. Testing agency will sample paint materials being used. Samples of material delivered to Project site
27 will be taken, identified, sealed, and certified in presence of Contractor.
- 28 b. Testing agency will perform tests for compliance of paint materials with product requirements.
- 29 c. If test results show materials being used do not comply with product requirements, Contractor shall
30 remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces
31 painted with rejected materials. Remove rejected materials from previously painted surfaces if, on
32 repainting with complying materials, the two paints are incompatible.
- 33 2. Dry Film Thickness:
34 a. Contractor shall touch up and restore painted surfaces damaged by testing.
- 35 b. If test results show that dry film thickness of applied paint does not comply with paint
36 manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as
37 needed to provide dry film thickness that complies with paint manufacturer's written instructions.
- 38 3.8 CLEANING AND PROTECTION
39 A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- 40 B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or
41 other methods. Do not scratch or damage adjacent finished surfaces.
- 42 C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by
43 cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- 44 D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

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SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

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23 PART 1 – GENERAL
24
25 1.1 SUMMARY
26 A. Section Includes:
27 1. Framing systems.
28 2. Suspension systems.
29 3. Grid suspension systems.
30 B. Related Requirements:
31 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-
32 bearing wall studs; floor joists; and roof rafters and ceiling joists.
33 1.2 SUBMITTALS
34 A. Product Data:
35 1. Framing systems.
36 2. Suspension systems.
37 3. Grid suspension systems.
38 B. Sustainable Design Submittals:
39 1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled
40 content not less than 30 percent.
41 2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
42 3. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and
43 preconsumer recycled content.
44 C. Product Certificates: For each type of code-compliance certification for studs and tracks.
45 1.3 DELIVERY, STORAGE, AND HANDLING
46 A. Notify manufacturer of damaged materials received prior to installation.
47 B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
48 C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and
49 handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."
50
51 PART 2 - PRODUCTS
52
53
54 2.1 PERFORMANCE REQUIREMENTS
55 A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in
56 assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an
57 independent testing agency.

- 1 B. Horizontal Deflection: For composite and non-composite wall assemblies, limited to 1/360 of the wall height based
2 on horizontal loading of 5 lbf/sq. ft. (239 Pa).
- 3 C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed
4 Steel Framing - Nonstructural Members," unless otherwise indicated.
- 5 D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. (239 Pa) minimum as required by the IBC.
- 6 2.2 FRAMING SYSTEMS
- 7 A. Framing Members, General: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.
- 8 1. Steel Sheet Components: Comply with AISI S220 and ASTM C645, Section 10 requirements for metal unless
9 otherwise indicated
- 10 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent
11 corrosion resistance. Galvannealed products are unacceptable.
- 12 a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to
13 authorities having jurisdiction.
- 14 B. Studs and Track: AISI S220 and ASTM C645, Section 10.
- 15 1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
- 16 2. Depth: As indicated on Drawings.
- 17 C. Slip-Type Head Joints: Where indicated, provide one of the following:
- 18 1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment
19 of studs to tracks while allowing 2-inch minimum vertical movement.
- 20 2. Single Long-Leg Track System: Top track with 2-inch- (51-mm-) deep flanges in thickness not less than
21 indicated for studs, installed with studs friction fit into top track and with continuous bridging located
22 within 12 inches (305 mm) of the top of studs to provide lateral bracing.
- 23 3. Double-Track System: Top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less
24 than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
- 25 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior
26 partition framing resulting from deflection of structure above; in thickness not less than indicated for studs
27 and in width to accommodate depth of studs.
- 28 D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-
29 inch- (13-mm-) wide flanges.
- 30 1. Depth: 1-1/2 inches.
- 31 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized
32 steel.
- 33 E. Hat-Shaped, Rigid Furring Channels:
- 34 1. Minimum Base-Steel Thickness: 0.0179 inch or as required by design.
- 35 2. Depth: As indicated on Drawings.
- 36 F. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
- 37 1. Configuration: Asymmetrical.
- 38 2. USG RC-1
- 39 G. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-)
40 wide flanges.
- 41 1. Depth: 3/4 inch.
- 42 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of
43 0.0329 inch (0.8 mm).
- 44 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or
45 double strand of 0.048-inch- (1.21-mm-) diameter wire.
- 46 H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of
47 3/4 inch (19 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit
48 insulation thickness indicated.
- 49 2.3 SUSPENSION SYSTEMS
- 50 A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double
51 strand of 0.048-inch- (1.21-mm-) diameter wire.
- 52 B. Hanger Attachments to Concrete:
- 53 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having
54 jurisdiction, based on ICC-ES AC01 or AC193 as appropriate for the substrate.
- 55 a. Uses: Securing hangers to structure.
- 56 b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or
57 ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

- 1 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having
- 2 jurisdiction, based on ICC-ES AC70.
- 3 C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- 4 D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch
- 5 (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
- 6 1. Depth: 2-1/2 inches opr as indicated on drawings.
- 7 E. Furring Channels (Furring Members):
- 8 1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-)
- 9 wide flanges, 3/4 inch (19 mm) deep.
- 10 2. Steel Studs and Tracks:
- 11 a. Minimum Base-Steel Thickness: 0.0179 inch or as required by design.
- 12 b. Depth: As indicated on Drawings.
- 13 3. Hat-Shaped, Rigid Furring Channels: 7/8 inch (22 mm) deep.
- 14 a. Minimum Base-Steel Thickness: 0.0179 inch or as required by design.
- 15 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound
- 16 transmission.
- 17 a. Configuration: Asymmetrical.
- 18 b. USG RC-1
- 19 2.4 GRID SUSPENSION SYSTEMS
- 20 A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and
- 21 cross-furring members that interlock.
- 22 2.5 AUXILIARY MATERIALS
- 23 A. General: Provide auxiliary materials that comply with referenced installation standards.
- 24 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other
- 25 properties required to fasten steel members to substrates.
- 26 B. Isolation Strip at Exterior Walls: Provide one of the following:
- 27 1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
- 28 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam
- 29 displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size
- 30
- 31 PART 3 - EXECUTION
- 32
- 33
- 34 3.1 EXAMINATION
- 35 A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors,
- 36 and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- 37 B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 38 3.2 PREPARATION
- 39 A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to
- 40 ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers
- 41 at spacing required to support the Work and that hangers will develop their full strength.
- 42 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time
- 43 needed for coordination and construction.
- 44 3.3 INSTALLATION, GENERAL
- 45 A. Installation Standard: ASTM C754.
- 46 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- 47 B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- 48 C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet
- 49 accessories, furnishings, or similar construction.
- 50 D. Install bracing at terminations in assemblies.
- 51 3.4 INSTALLATION OF FRAMING SYSTEMS
- 52 A. Install framing system components according to spacings indicated, but not greater than spacings required by
- 53 referenced installation standards for assembly types.
- 54 1. Single-Layer Application: As required by horizontal deflection performance requirements but not greater
- 55 than 16 inches (406 mm) o.c. unless otherwise indicated.
- 56 2. Multilayer Application: As required by horizontal deflection performance requirements but not greater than
- 57 16 inches (406 mm) o.c. unless otherwise indicated.

- 1 3. Tile Backing Panels: As required by horizontal deflection performance requirements but not greater than 16
2 inches (406 mm) o.c. unless otherwise indicated.
- 3 B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install
4 isolation strip between studs and exterior wall.
- 5 C. Install studs so flanges within framing system point in same direction.
- 6 D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above
7 suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing
8 around ducts that penetrate partitions above ceiling.
- 9 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at
10 tops of framing systems that prevent axial loading of finished assemblies.
- 11 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for
12 cripple studs) at head and secure to jamb studs.
- 13 a. Install two studs at each jamb unless otherwise indicated.
- 14 b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
- 15 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings
16 unless otherwise indicated. Install framing below sills of openings to match framing required above door
17 heads.
- 18 4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- 19 E. Direct Furring:
- 20 1. Screw to wood framing.
- 21 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven
22 fasteners spaced 24 inches (610 mm) o.c.
- 23 F. Z-Shaped Furring Members:
- 24 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped
25 furring members spaced 24 inches o.c.
- 26 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub
27 nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- 28 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond
29 corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel.
30 At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation
31 to fit.
- 32 G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from
33 the plane formed by faces of adjacent framing.
- 34 3.5 INSTALLATION OF SUSPENSION SYSTEMS
- 35 A. Install suspension system components according to spacings indicated, but not greater than spacings required by
36 referenced installation standards for assembly types.
- 37 1. Hangers: 48 inches o.c.
- 38 2. Carrying Channels (Main Runners): 48 inches o.c.
- 39 3. Furring Channels (Furring Members): 16 inches o.c.
- 40 B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to
41 prevent transfer of loading imposed by structural movement.
- 42 C. Suspend hangers from building structure as follows:
- 43 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are
44 not part of supporting structural or suspension system.
- 45 a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by
46 bracing, countersplaying, or other equally effective means.
- 47 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere
48 with locations of hangers required to support standard suspension system members, install supplemental
49 suspension members and hangers in the form of trapezes or equivalent devices.
- 50 a. Size supplemental suspension members and hangers to support ceiling loads within performance
51 limits established by referenced installation standards.
- 52 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or
53 other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not
54 cause hangers to deteriorate or otherwise fail.
- 55 4. Do not attach hangers to steel roof deck.
- 56 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- 1 3.6 INSTALLATION OF GRID SUSPENSION SYSTEMS
- 2 A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical
- 3 surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- 4 3.7 FIELD QUALITY CONTROL
- 5 A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise
- 6 on each member that will receive finishes and transversely between parallel members that will receive finishes.
- 7
- 8

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**SECTION 09 29 00
 GYPSUM BOARD**

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 27 PART 1 – GENERAL
 28
 29 1.1 SUMMARY
 30 A. Section Includes:
 31 1. Interior gypsum board.
 32 2. Tile backing panels.
 33 3. PVC Ceiling panels.
 34 B. Related Requirements:
 35 1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
 36 2. Section 079219 "Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
 37 3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems
 38 that support gypsum board panels.
 39 1.2 SUBMITTALS
 40 A. Product Data: For the following:
 41 1. Gypsum wallboard.
 42 2. Gypsum ceiling board.
 43 3. Mold-resistant gypsum board.
 44 4. Cementitious backer units.
 45 5. Joint treatment materials.
 46 6. Laminating adhesive.
 47 7. Sound-attenuation blankets.
 48 8. PVC Ceiling panels.
 49 B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections,
 50 details of components, and attachments to other work.
 51 C. Sustainable Design Submittals:
 52 1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less
 53 than 70 percent.
 54 2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 55 3. Verify ceiling and wall materials comply with the requirements of the California Department of Public
 56 Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from
 57 Indoor Sources Using Environmental Chambers."

- 1 4. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-
2 emitting materials.
- 3 5. Regional Materials: Manufacture products within 100 miles (160 km) of Project site from materials that
4 have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of
5 Project site.
- 6 6. Verify adhesives have a VOC content of 50 g/L or less.
- 7 7. Product Data: For adhesives and sealants, indicating VOC content.
- 8 8. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-
9 emitting materials.
- 10 1.3 DELIVERY, STORAGE AND HANDLING
- 11 A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight,
12 construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat
13 platform to prevent sagging.
- 14 1.4 FIELD CONDITIONS
- 15 A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written
16 instructions, whichever are more stringent.
- 17 B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- 18 C. Do not install panels that are wet, moisture damaged, and mold damaged.
- 19 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging,
20 or irregular shape.
- 21 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface
22 contamination and discoloration.
- 23
- 24 PART 2 - PRODUCTS
- 25
- 26
- 27 2.1 SOURCE LIMITATIONS
- 28 A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products
29 of consistent quality in appearance and physical properties.
- 30 2.2 PERFORMANCE REQUIREMENTS
- 31 A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in
32 assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent
33 testing agency.
- 34 2.3 GYPSUM BOARD, GENERAL
- 35 A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with
36 support system indicated.
- 37 2.4 INTERIOR GYPSUM BOARD
- 38 A. Gypsum Wallboard: ASTM C1396/C1396M.
- 39 1. Thickness: 5/8 inch.
- 40 2. Long Edges: Tapered.
- 41 B. Gypsum Ceiling Board: ASTM C1396/C1396M.
- 42 1. Thickness: 1/2 inch (12.7 mm).
- 43 2. Long Edges: Tapered.
- 44 C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
- 45 1. Core: 5/8 inch.
- 46 2. Long Edges: Tapered.
- 47 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- 48 2.5 TILE BACKING PANELS
- 49 A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
- 50 1. Thickness: 5/8 inch.
- 51 2. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- 52 2.6 PVC CEILING PANELS
- 53 A. Manufacture: Trusscore or equal.
- 54 B. Tightly interlocking 16" wide PVC wall and ceiling panels that are waterproof, durable, and easy to install and
55 maintain.
- 56 C. Panel:
- 57 1. 1/2 inch thick, 16" wide (exposed face) panel with inner truss design.
- 58 2. Hidden fasteners & pre-punched screw flange.

- 1 3. Highly resistant to chemicals and unaffected by moisture.
- 2 4. Color: White.
- 3 5. Class A fire performance (ASTM E84/ULC S102)
- 4 D. Accessories
- 5 1. Silicone Sealant: One-part, neutral cure silicone sealant is used to seal all corners, around all fixtures, and
- 6 apply a bead of silicone inside the grooved end of the panel prior to inserting the next panel. Sealant color
- 7 should match the panels.
- 8 2. J trims.
- 9 3. H Channel trim kits.
- 10 2.7 TRIM ACCESSORIES
- 11 A. Interior Trim: ASTM C1047.
- 12 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel
- 13 sheet.
- 14 2. Shapes:
- 15 a. Cornerbead.
- 16 b. Bullnose bead.
- 17 c. LC-Bead: J-shaped; exposed long flange receives joint compound.
- 18 d. L-Bead: L-shaped; exposed long flange receives joint compound.
- 19 e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- 20 f. Expansion (control) joint.
- 21 2.8 JOINT TREATMENT MATERIALS
- 22 A. General: Comply with ASTM C475/C475M.
- 23 B. Joint Tape:
- 24 1. Interior Gypsum Board: Paper.
- 25 2. Tile Backing Panels: As recommended by panel manufacturer.
- 26 C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other
- 27 compounds applied on previous or for successive coats.
- 28 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
- 29 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use
- 30 setting-type taping compound.
- 31 a. Use setting-type compound for installing paper-faced metal trim accessories.
- 32 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
- 33 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
- 34 D. Joint Compound for Tile Backing Panels:
- 35 1. Cementitious Backer Units: As recommended by backer unit manufacturer.
- 36 2.9 AUXILIARY MATERIALS
- 37 A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written
- 38 instructions.
- 39 B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to
- 40 continuous substrate.
- 41 C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
- 42 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch
- 43 (0.84 to 2.84 mm) thick.
- 44 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- 45 D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining
- 46 thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
- 47 E. Acoustical Sealant: As specified in Section 079219 "Joint Sealants."
- 48 F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- 49
- 50 PART 3 - EXECUTION
- 51
- 52
- 53 3.1 EXAMINATION
- 54 A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present,
- 55 for compliance with requirements and other conditions affecting performance of the Work.
- 56 B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- 57 C. Proceed with installation only after unsatisfactory conditions have been corrected.

- 1 3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL
- 2 A. Comply with ASTM C840.
- 3 B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints
- 4 in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- 5 C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16
- 6 inch (1.5 mm) of open space between panels. Do not force into place.
- 7 D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum
- 8 board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger
- 9 vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed
- 10 openings.
- 11 E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- 12 F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases
- 13 braced internally.
- 14 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be
- 15 accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
- 16 2. Fit gypsum panels around ducts, pipes, and conduits.
- 17 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut
- 18 gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide
- 19 joints to install sealant.
- 20 G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to
- 21 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels
- 22 are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- 23 H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported)
- 24 edges of stud flanges first.
- 25 I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations
- 26 with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and
- 27 through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim
- 28 and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical
- 29 ceilings.
- 30 J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels
- 31 have been installed on one side.
- 32 3.3 INSTALLATION OF INTERIOR GYPSUM BOARD
- 33 A. Install interior gypsum board in the following locations:
- 34 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
- 35 2. Ceiling Type: Ceiling surfaces.
- 36 3. Mold-Resistant Type: As indicated on Drawings.
- 37 B. Single-Layer Application:
- 38 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at
- 39 right angles to framing unless otherwise indicated.
- 40 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or
- 41 required by fire-resistance-rated assembly, and minimize end joints.
- 42 a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
- 43 b. At high walls, install panels horizontally unless otherwise indicated.
- 44 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints.
- 45 Locate edge joints over furring members.
- 46 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- 47 C. Multilayer Application:
- 48 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions;
- 49 apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-
- 50 layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless
- 51 otherwise indicated or required by fire-resistance-rated assembly.
- 52 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to
- 53 framing) with joints of base layers located over stud or furring member and face-layer joints offset at least
- 54 one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-
- 55 rated assembly. Stagger joints on opposite sides of partitions.
- 56 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically
- 57 (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring
- 58 member. Locate edge joints of base layer over furring members.

- 1 4. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary
2 fasteners.
- 3 D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs,
4 joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written
5 instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- 6 3.4 INSTALLATION OF TILE BACKING PANELS
- 7 A. Cementitious Backer Units: ANSI A108.11, at [showers, tubs, and where indicated on Drawings and locations
8 indicated to receive solid surface wall panels and tile.
- 9 B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane
10 across panel surfaces.
- 11 3.5 INSTALLATION OF PVC CEILING PANELS
- 12 A. designed to be installed with screws. Use stainless steel, self-tapping screws with a flat-bottomed, low profile head
13 and a minimum head diameter of 3/8".
- 14 3.6 INSTALLATION OF TRIM ACCESSORIES
- 15 A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels.
16 Otherwise, attach trim according to manufacturer's written instructions.
- 17 B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect
18 for visual effect.
- 19 C. Interior Trim: Install in the following locations:
- 20 1. Cornerbead: Use at outside corners.
- 21 2. LC-Bead: Use at exposed panel edges.
- 22 3. L-Bead: Use where indicated on Drawings.
- 23 4. U-Bead: Use where indicated on Drawings.
- 24 3.7 FINISHING OF GYPSUM BOARD
- 25 A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface
26 defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual
27 joint compound from adjacent surfaces.
- 28 B. Prefill open joints and damaged surface areas.
- 29 C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive
30 tape.
- 31 D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:
- 32 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
- 33 2. Level 2: Panels that are substrate for tile.
- 34 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
- 35 a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- 36 E. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- 37 3.8 PROTECTION
- 38 A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall
39 surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- 40 B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other
41 causes during remainder of the construction period.
- 42 C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
- 43 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging,
44 or irregular shape.
- 45 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface
46 contamination and discoloration.
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**SECTION 09 30 13
CERAMIC TILING**

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30	PART 1 – GENERAL		
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32	1.1 SUMMARY		
33	A. Section Includes:		
34	1. Porcelain tile.		
35	2. Waterproof membranes.		
36	3. Setting material.		
37	4. Grout materials.		
38	B. Related Requirements:		
39	1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.		
40	2. Section 092900 "Gypsum Board" for tile backing panels.		
41	1.2 DEFINITIONS		
42	A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this		
43	Section unless otherwise specified.		
44	B. Face Size: Actual tile size, excluding spacer lugs.		
45	C. Large Format Tile: Tile with at least one edge 15 inches (381 mm) or longer.		
46	D. Module Size: Actual tile size plus joint width indicated.		
47	1.3 PREINSTALLATION MEETINGS		
48	A. Preinstallation Conference: Conduct conference at Project site.		
49	1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.		
50	1.4 SUBMITTALS		
51	A. Product Data:		
52	1. Porcelain tile.		
53	2. Ceramic tile.		
54	3. Waterproof membranes.		
55	4. Setting material.		
56	5. Grout materials.		
57	B. Samples for Verification:		

- 1 1. Full-size units of each type and composition of tile and for each color and finish required. For tile with
- 2 aesthetic classification V3 or V4, provide 12 tiles from same production run.
- 3 2. Full-size units of each type of trim and accessory.
- 4 3. Metal flooring transitions 6-inch (152-mm) lengths.
- 5 C. Sustainable Design Submittals:
- 6 1. Environmental Product Declaration: For each product.
- 7 2. Health Product Declaration: For each product.
- 8 3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- 9 4. Product Data: For adhesives, indicating VOC content.
- 10 5. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting
- 11 materials.
- 12 D. Qualification Data: For Installer.
- 13 E. Product Certificates: For each type of product, including product use classification.
- 14 F. Product Test Reports:
- 15 1. Tile-setting and -grouting products.
- 16 2. Certified porcelain tile.
- 17 3. Slip-resistance test reports from qualified independent testing agency.
- 18 1.5 MAINTENANCE MATERIAL SUBMITTALS
- 19 A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products
- 20 installed and that are packaged with protective covering for storage and identified with labels describing contents.
- 21 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type,
- 22 composition, color, pattern, and size indicated.
- 23 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and
- 24 color indicated.
- 25 1.6 MOCKUPS
- 26 A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set
- 27 quality standards for materials and execution.
- 28 1. Build mockup of floor tile installation.
- 29 2. Build mockup of wall tile installation.
- 30 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if
- 31 undisturbed at time of Substantial Completion.
- 32 1.7 DELIVERY, STORAGE, AND HANDLING
- 33 A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.
- 34 Comply with requirements in ANSI A137.1 for labeling tile packages.
- 35 B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- 36 C. Store aggregates where grading and other required characteristics can be maintained and contamination can be
- 37 avoided.
- 38 D. Store liquid materials in unopened containers and protected from freezing.
- 39 1.8 FIELD CONDITIONS
- 40 A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and
- 41 humidity conditions are maintained at the levels indicated in "Referenced Standards" Article in the Evaluations and
- 42 manufacturer's written instructions.
- 43 1.9 WARRANTY
- 44 A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace
- 45 defective installation areas, material, and labor that fail under normal usage within specified warranty period.
- 46 1. Warranty Period: Five years from date of Product Purchase.
- 47
- 48 PART 2 - PRODUCTS
- 49
- 50
- 51 2.1 SOURCE LIMITATIONS
- 52 A. Tile: Obtain tile of each type and color or finish from single source or producer.
- 53 1. Obtain tile of each type and color or finish from same production run and of consistent quality in
- 54 appearance and physical properties for each contiguous area.
- 55 2.2 PRODUCTS, GENERAL
- 56 A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other
- 57 characteristics indicated.
- 58 1. Provide tile complying with Standard Grade requirements.

- 1 B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards
- 2 referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile
- 3 installation schedules, and other requirements specified.
- 4 C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units
- 5 taken from one package show same range in colors as those taken from other packages and match approved
- 6 Samples.
- 7 D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer
- 8 unless otherwise indicated.
- 9 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless
- 10 tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has
- 11 a record of successful in-service performance.
- 12 E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile
- 13 against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot.
- 14 Do not coat unexposed tile surfaces.

15 2.3 PORCELAIN TILE

- 16 A. Porcelain Tile Type CT-1: **Unglazed.**
- 17 1. Manufacture: Daltile.
- 18 2. Product: Haut Monde.
- 19 3. Certification: Tile certified by the Porcelain Tile Certification Agency.
- 20 4. Face Size: 2 by 2 mosaic sheet of 12 x 12.
- 21 5. Thickness: 5/16 **inch.**
- 22 6. Pattern: Running bond
- 23 7. Tile Color: Glitterati Granite HM03.
- 24 8. Grout Color: **As selected by Architect from manufacturer's full range.**
- 25 9. Precoat with temporary protective coating.
- 26 10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable **and matching**
- 27 **characteristics of adjoining flat tile.** Provide shapes as follows, selected from manufacturer's standard
- 28 shapes:
- 29 a. Cove Base: 6 x 24.
- 30 11. Grout width: 1/8-inch.
- 31 B. Porcelain Tile Type CT-2: **Unglazed.**
- 32 1. Manufacture: Daltile.
- 33 2. Product: Haut Monde.
- 34 3. Certification: Tile certified by the Porcelain Tile Certification Agency.
- 35 4. Face Size: 12 by 24.
- 36 5. Thickness: 5/16 **inch.**
- 37 6. Pattern: Straight set
- 38 7. Tile Color: Glitterati Granite HM03.
- 39 8. Grout Color: **As selected by Architect from manufacturer's full range.**
- 40 9. Precoat with temporary protective coating.
- 41 10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable **and matching**
- 42 **characteristics of adjoining flat tile.** Provide shapes as follows, selected from manufacturer's standard
- 43 shapes:
- 44 a. Cove Base: 6 x 24.
- 45 11. Grout width: 1/8-inch.

46 2.4 WATERPROOF MEMBRANES

- 47 A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and
- 48 ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and
- 49 accessories recommended by manufacturer.
- 50 B. Waterproof Membrane, Sheet: Polyethylene sheet faced on one or both sides with polyester fabric.
- 51 1. Nominal Thickness: 0.02 inch.
- 52 C. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer with continuous fabric
- 53 reinforcement.

54 2.5 SETTING MATERIALS

- 55 A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
- 56 1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.
- 57 2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with
- 58 ASTM A1064/A1064M except for minimum wire size.

- 1 3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging
- 2 water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland
- 3 cement and aggregate mortar bed.
- 4 B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
- 5 1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to
- 6 other requirements in ANSI A118.4.
- 7 2.6 GROUT MATERIALS
- 8 A. High-Performance Tile Grout: ANSI A118.7.
- 9 1. Polymer Type:
- 10 a. Dry, redispersible form, prepackaged with other dry ingredients.
- 11 b. Liquid-latex form for addition to prepackaged dry-grout mix.
- 12 2.7 MISCELLANEOUS MATERIALS
- 13 A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided
- 14 or approved by manufacturer of tile-setting and adhesive materials for installations indicated.
- 15 B. Metal Flooring Transitions: Profile designed specifically for flooring applications; height to match tile and setting-
- 16 bed thickness.
- 17 1. Description: Schluter Reno-TK, Schluter Reno-U, and Schluter Dilex-EHK.
- 18 2. Material and Finish: Stainless Steel Type 304 exposed-edge material.
- 19 C. Metal Edge Trim: Profile designed for wall terminations and edge protection.
- 20 1. Description: Schluter Quadec, Schluter Schiene, Schluter ECK-K.
- 21 2. Terminations: End caps and Outside corners matching edge-protection profile.
- 22 3. Material and Finish: Stainless Steel Type 304 exposed-edge material.
- 23 D. Temporary Protective Coating: Formulated to protect exposed surfaces of tile against adherence of mortar and
- 24 grout; compatible with tile, mortar, and grout products and easily removable after grouting is completed without
- 25 damaging grout or tile.
- 26 E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces,
- 27 specifically approved for materials and installations indicated by tile and grout manufacturers.
- 28 F. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or
- 29 appearance of grout.

30
31 **PART 3 - EXECUTION**

- 32
- 33
- 34 3.1 EXAMINATION
- 35 A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with
- 36 requirements for installation tolerances and other conditions affecting performance of the Work.
- 37 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-
- 38 setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone;
- 39 and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
- 40 2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply
- 41 with surface finish requirements in ANSI A108.01 for installations indicated.
- 42 a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
- 43 b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
- 44 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and
- 45 similar items located in or behind tile has been completed.
- 46 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated,
- 47 adjust joint locations in consultation with Architect.
- 48 B. Proceed with installation only after unsatisfactory conditions have been corrected.

49 3.2 PREPARATION

- 50 A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.
- 51 B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable
- 52 leveling and patching compound specifically recommended by tile-setting material manufacturer.
- 53 C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that
- 54 complies with ANSI A108.1 and is sloped 1/4 inch per foot (1:50) toward drains.
- 55 D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units
- 56 taken from one package show same range of colors as those taken from other packages and match approved
- 57 Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- 58 E. Substrate Flatness:

- 1 1. For tile shorter than 15 inches (381 mm), confirm that structure or substrate is limited to variation of
- 2 1/4 inch in 10 ft. (6.4 mm in 3 m) from the required plane, and no more than 1/16 inch in 12 inches (1.5 mm
- 3 in 300 mm) when measured from tile surface high points.
- 4 2. For large format tile, tile with at least one edge 15 inches (381 mm) or longer, confirm that structure or
- 5 substrate is limited to 1/8 inch in 10 ft. (3 mm in 3 m) from the required plane, and no more than
- 6 1/16 inch in 24 inches (1.5 mm in 609 mm) when measured from tile surface high points.
- 7 3.3 INSTALLATION OF CERAMIC TILE SYSTEM
- 8 A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions
- 9 for type of application indicated.
- 10 B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce
- 11 waterproof membrane of uniform thickness that is bonded securely to substrate.
- 12 1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting
- 13 materials over it.
- 14 C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce
- 15 membrane of uniform thickness that is bonded securely to substrate.
- 16 1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- 17 D. Mix mortars and grouts to comply with "Referenced Standards" Article in the Evaluations and mortar and grout
- 18 manufacturers' written instructions.
- 19 1. Add materials, water, and additives in accurate proportions.
- 20 2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other
- 21 procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for
- 22 installations indicated.
- 23 E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA
- 24 installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are
- 25 referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting
- 26 and grouting materials used.
- 27 1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for
- 28 providing 95 percent mortar coverage:
- 29 a. Tile floors in wet areas.
- 30 b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
- 31 c. Tile floors consisting of rib-backed tiles.
- 32 2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering
- 33 without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and
- 34 corners without disrupting pattern or joint alignments.
- 35 3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible
- 36 surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit
- 37 tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap
- 38 tile.
- 39 4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- 40 5. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in
- 41 both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less
- 42 than half of a tile. Provide uniform joint widths unless otherwise indicated.
- 43 a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets,
- 44 so joints between sheets are not apparent in finished Work.
- 45 b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align
- 46 joints.
- 47 c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base,
- 48 walls, or trim, align joints unless otherwise indicated.
- 49 F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and
- 50 isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and
- 51 tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after
- 52 installing tiles.
- 53 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- 54 G. Metal Flooring Transitions: Install at locations indicated.
- 55 H. Metal Wall Trim: Install at locations indicated.
- 56 3.4 ADJUSTING AND CLEANING
- 57 A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units,
- 58 installed as specified and in a manner to eliminate evidence of replacement.

- 1 B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign
2 matter.
3 1. Remove grout residue from tile as soon as possible.
4 2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions.
5 Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners
6 are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and
7 plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- 8 3.5 PROTECTION
- 9 A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining,
10 damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile
11 walls and floors.
- 12 B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- 13 C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.
- 14 3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE
- 15 A. Interior Floor Installations, Concrete Subfloor:
- 16 1. TCNA F113: Modified dry-set mortar (thinset) installed over concrete slab-on-grade.
17 a. Ceramic Tile Type: CT-2.
18 b. Thinset Mortar Bond Coat: Modified dry-set mortar.
19 c. Grout: High-performance unsanded cement grout.
20 d. Joint Width: 1/8 inch.
- 21 2. TCNA F121: Method ANSI A108.1A. Portland Cement mortar bed (thickset) with waterproof membrane.
22 a. Ceramic Tile Type: CT-1.
23 b. Mortar Bed: Portland cement mortar.
24 c. Thinset Mortar: Modified dry-set mortar.
25 d. Grout: High-performance unsanded cement grout.
26 e. Waterproof Membrane: Polyethylene sheet or Fabric-reinforced, fluid-applied membrane].
27 f. Joint Width: 1/8 inch.
- 28 B. Interior Wall Installations, Metal Studs:
- 29 1. TCNA W244C: Thinset mortar on cementitious backer board.
30 a. Ceramic Tile Type: CT-2.
31 b. Thinset Mortar: Modified dry-set] mortar.
32 c. Grout: High-performance unsanded cement grout.
33 d. Joint Width: 1/8 inch.
- 34
35
36

END OF SECTION

SECTION 09 51 13
ACOUSTIC PANEL CEILINGS

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23 PART 1 – GENERAL
24
25 1.1 SUMMARY
26 A. Section Includes:
27 1. Acoustical panels.
28 2. Metal suspension system.
29 B. Related Requirements:
30 1.2 SUBMITTALS
31 A. Product Data:
32 1. Acoustical panels.
33 2. Metal suspension system.
34 B. Sustainable Design Submittals:
35 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
36 2. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and
37 preconsumer recycled content.
38 3. Product Certificates: For materials manufactured within 100 miles (160 km) of Project, indicating location of
39 material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance
40 to Project and cost for each raw material.
41 4. Environmental Product Declaration: For each product.
42 5. Health Product Declaration: For each product.
43 6. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
44 7. Health Product Declaration (HPD): For each product.
45 8. Laboratory Test Reports: For ceiling products, indicating compliance with requirements for low-emitting
46 materials.
47 C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
48 D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples
49 of sizes indicated below:
50 1. Acoustical Panels: Set of 6-inch- square Samples of each type, color, pattern, and texture.
51 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish,
52 and color.
53 E. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.
54 F. Maintenance Data: For finishes to include in maintenance manuals.
55 1.3 DELIVERY, STORAGE, AND HANDLING
56 A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully
57 enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature
58 extremes, direct sunlight, surface contamination, and other causes.

- 1 B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
2 1.4 FIELD CONDITIONS
3 A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-
4 work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity
5 conditions are maintained at the levels indicated for Project when occupied for its intended use.
6

7 PART 2 - PRODUCTS
8
9

- 10 2.1 SOURCE LIMITATIONS
11 A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension
12 system from single source from single manufacturer.
13 2.2 PERFORMANCE REQUIREMENTS
14 A. Verify ceiling products comply with the requirements of the California Department of Public Health's "Standard
15 Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using
16 Environmental Chambers."
17 B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with
18 appropriate markings of applicable testing agency.
19 1. Flame-Spread Index: Class A in accordance with ASTM E1264.
20 2. Smoke-Developed Index: 50 or less.
21 2.3 ACOUSTICAL PANELS (ACT-1)
22 A. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated
23 by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
24 B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 40
25 percent.
26 C. Classification: Provide panels as follows:
27 1. Type and Form, Type IV Form 2: Mineral base with membrane-faced overlay.
28 2. Pattern: E (lightly textured).
29 D. Color: White.
30 E. Light Reflectance (LR): Not less than 0.85.
31 F. Ceiling Attenuation Class (CAC): Not less than 35.
32 G. Noise Reduction Coefficient (NRC): Not less than 0.85.
33 H. Articulation Class (AC): Not less than 170.
34 I. Edge/Joint Detail: Square Tegular.
35 J. Thickness:
36 1. 1 inch.
37 K. Modular Size: 24 by 24 inches.
38 L. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus,
39 mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth
40 when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with
41 ASTM D3274 or ASTM G21.
42 2.4 METAL SUSPENSION SYSTEM
43 A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and
44 accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish
45 indicated.
46 B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 90
47 percent.
48 C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled
49 steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with
50 prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.
51 1. Structural Classification: Intermediate duty system.
52 2. End Condition of Cross Runners: butt-edge type.
53 3. Face Design: Flat, flush].
54 4. Cap Material: Cold-rolled steel.
55 5. Cap Finish: Painted white.
56 2.5 ACCESSORIES
57 A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung,"
58 unless otherwise indicated.

- 1 2. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching
- 2 hangers of type indicated and with capability to sustain, without failure, a load equal to five times that
- 3 imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or
- 4 ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
- 5 a. Type: Postinstalled expansion or bonded anchors.
- 6 b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633,
- 7 Class SC 1 (mild) service condition.
- 8 B. Wire Hangers, Braces, and Ties: Provide wires as follows:
- 9 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
- 10 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1,
- 11 "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- 12 C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- 13 D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- 14 E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick,
- 15 galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections
- 16 and 5/16-inch- (8-mm-) diameter bolts.
- 17 2.6 ACOUSTICAL SEALANT
- 18 A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- 19

20 PART 3 - EXECUTION

- 21
- 22
- 23 3.1 EXAMINATION
- 24 A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or
- 25 abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling
- 26 installation and anchorage and with requirements for installation tolerances and other conditions affecting
- 27 performance of acoustical panel ceilings.
- 28 B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold
- 29 damaged.
- 30 C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 31 3.2 PREPARATION
- 32 A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of
- 33 each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout
- 34 shown on reflected ceiling plans.
- 35 B. Layout openings for penetrations centered on the penetrating items.
- 36 3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS
- 37 A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.
- 38 B. Suspend ceiling hangers from building's structural members and as follows:
- 39 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are
- 40 not part of supporting structure or of ceiling suspension system.
- 41 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing,
- 42 countersplaying, or other equally effective means.
- 43 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere
- 44 with location of hangers at spacings required to support standard suspension-system members, install
- 45 supplemental suspension members and hangers in form of trapezes or equivalent devices.
- 46 4. When steel framing does not permit installation of hanger wires at spacing required, install carrying
- 47 channels or other supplemental support for attachment of hanger wires.
- 48 5. Do not attach hangers to steel deck tabs.
- 49 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
- 50 7. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from
- 51 hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each
- 52 member.
- 53 8. Size supplemental suspension members and hangers to support ceiling loads within performance limits
- 54 established by referenced standards.
- 55 C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to
- 56 conceal edges of acoustical panels.
- 57 1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3
- 58 inches (75 mm) from ends. Miter corners accurately and connect securely.

- 1 D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and
- 2 replace dented, bent, or kinked members.
- 3 E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge
- 4 moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
- 5 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system
- 6 runners and moldings.

7 3.4 ERECTION TOLERANCES

- 8 A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- 9 B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of
- 10 1/8 inch in 12 feet, non-cumulative.

11 3.5 CLEANING

- 12 A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system
- 13 members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- 14 B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate
- 15 evidence of damage.
- 16
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18 **END OF SECTION**

**SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES**

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11 2.2 THERMOPLASTIC-RUBBER BASE (RB-1) 2
12 2.3 RUBBER MOLDING ACCESSORY 2
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18 3.4 RESILIENT ACCESSORY INSTALLATION 3
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21 PART 1 – GENERAL
22
23 1.1 SUMMARY
24 A. Section Includes:
25 1. Thermoplastic-rubber base.
26 2. Rubber molding accessories.
27 1.2 SUBMITTALS
28 A. Product Data: For each type of product.
29 B. Sustainable Design Submittals:
30 1. Product Data: For adhesives, indicating VOC content.
31 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting
32 materials.
33 3. Product Data: For sealants, indicating VOC content.
34 4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
35 5. Laboratory Test Reports: For resilient base and stair products and accessories, indicating compliance with
36 requirements for low-emitting materials.
37 6. Environmental Product Declaration: For each product.
38 7. Health Product Declaration: For each product.
39 8. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
40 C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in
41 manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
42 D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.
43 1.3 DELIVERY, STORAGE, AND HANDLING
44 A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient
45 temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or
46 more than 90 deg F (32 deg C).
47 1.4 FIELD CONDITIONS
48 A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more
49 than 95 deg F, in spaces to receive resilient products during the following periods:
50 1. 48 hours before installation.
51 2. During installation.
52 3. 48 hours after installation.
53 B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by
54 manufacturer, but not less than 55 deg F or more than 95 deg F.
55 C. Install resilient products after other finishing operations, including painting, have been completed.
56

1 PART 2 - PRODUCTS

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4 2.1 PERFORMANCE REQUIREMENTS

5 A. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for
6 the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental
7 Chambers."

8 2.2 THERMOPLASTIC-RUBBER BASE (RB-1)

9 A. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).

10 1. Group: II (layered).

11 2. Style and Location:

12 a. Style A, Straight: Provide in areas with carpet.

13 b. Style B, Cove: Provide in areas with resilient floor coverings.

14 B. Thickness: 0.125 inch .

15 C. Height: 4 inches.

16 D. Lengths: Coils in manufacturer's standard length.

17 E. Outside Corners: Job formed or preformed.

18 F. Inside Corners: Job formed or preformed.

19 G. Colors: As selected from manufacture's full line.

20 2.3 RUBBER MOLDING ACCESSORY

21 A. Description: transition strips.

22 B. Profile and Dimensions: As indicated.

23 C. Locations: Provide rubber molding accessories in areas indicated.

24 D. Colors and Patterns: As selected from manufacture's full line.

25 2.4 INSTALLATION MATERIALS

26 A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-
27 cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

28 B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and
29 substrate conditions indicated.

30 1. Verify adhesives have a VOC content of 50g/L or less.

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32 PART 3 - EXECUTION

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35 3.1 EXAMINATION

36 A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and
37 other conditions affecting performance of the Work.

38 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections
39 and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere
40 with adhesion of resilient products.

41 B. Proceed with installation only after unsatisfactory conditions have been corrected.

42 1. Installation of resilient products indicates acceptance of surfaces and conditions.

43 3.2 PREPARATION

44 A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

45 B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps
46 and ridges to produce a uniform and smooth substrate.

47 C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

48 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces
49 where they will be installed.

50 D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

51 3.3 RESILIENT BASE INSTALLATION

52 A. Comply with manufacturer's written instructions for installing resilient base.

53 B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures
54 in rooms and areas where base is required.

55 C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

56 D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with
57 horizontal and vertical substrates.

58 E. Do not stretch resilient base during installation.

- 1 F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with
- 2 manufacturer's recommended adhesive filler material.
- 3 G. Preformed Corners: Install preformed corners before installing straight pieces.
- 4 H. Job-Formed Corners:
- 5 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3
- 6 inches in length.
- 7 a. Form without producing discoloration (whitening) at bends.
- 8 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3
- 9 inches in length.
- 10 a. Miter or cope corners to minimize open joints.
- 11 3.4 RESILIENT ACCESSORY INSTALLATION
- 12 A. Comply with manufacturer's written instructions for installing resilient accessories.
- 13 B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each
- 14 piece. Install reducer strips at edges of floor covering that would otherwise be exposed.
- 15 3.5 CLEANING AND PROTECTION
- 16 A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- 17 B. Perform the following operations immediately after completing resilient-product installation:
- 18 1. Remove adhesive and other blemishes from surfaces.
- 19 C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and
- 20 placement of equipment and fixtures during remainder of construction period.
- 21 D. Cover resilient products subject to wear and foot traffic until Substantial Completion.
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END OF SECTION

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**SECTION 09 65 19
RESILIENT TILE FLOORING**

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12 2.2 INSTALLATION MATERIALS 2
13 PART 3 - EXECUTION 2
14 3.1 EXAMINATION 2
15 3.2 PREPARATION 2
16 3.3 FLOOR TILE INSTALLATION 3
17 3.4 CLEANING AND PROTECTION 3
18
19 PART 1 – GENERAL
20
21 1.1 SUMMARY
22 A. Section Includes:
23 1. Rubber floor tile.
24 1.2 SUBMITTALS
25 A. Product Data: For each type of product.
26 B. Sustainable Design Submittals:
27 1. Product Data: For adhesives, indicating VOC content.
28 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting
29 materials.
30 3. Product Data: For chemical-bonding compounds, indicating VOC content.
31 4. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for
32 low-emitting materials.
33 5. Product Data: For sealants, indicating VOC content.
34 6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
35 7. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting
36 materials.
37 8. Environmental Product Declaration: For each product.
38 9. Health Product Declaration: For each product.
39 10. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
40 C. Samples for Initial Selection: For each type of floor tile indicated.
41 D. Maintenance Data: For each type of floor tile to include in maintenance manuals.
42 1.3 MAINTENANCE MATERIAL SUBMITTALS
43 A. Furnish extra materials, from the same product run, that match products installed and that are packaged with
44 protective covering for storage and identified with labels describing contents.
45 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor
46 tile installed.
47 1.4 DELIVERY, STORAGE, AND HANDLING
48 A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures
49 maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90
50 deg F (32 deg C). Store floor tiles on flat surfaces.
51 1.5 FIELD CONDITIONS
52 A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more
53 than 95 deg F, in spaces to receive floor tile during the following periods:
54 1. 48 hours before installation.
55 2. During installation.
56 3. 48 hours after installation.
57 B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by
58 manufacturer, but not less than 55 deg F or more than 95 deg F.

- 1 C. Close spaces to traffic during floor tile installation.
- 2 D. Close spaces to traffic for 48 hours after floor tile installation.
- 3 E. Install floor tile after other finishing operations, including painting, have been completed.

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5 PART 2 - PRODUCTS

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8 2.1 RUBBER FLOOR TILE (RF-1)

- 9 A. Manufacture: Interface / Nora.
- 10 B. Product: Norament Grano
- 11 C. Color: As selected from manufacture's full line.
- 12 D. Tile Standard: ASTM F1344, Class I-B, Homogeneous Rubber Tile, through mottled as required by color.
- 13 E. Hardness: Grade 2, minimum hardness of 70, measured using Shore, Type A durometer according to ASTM D2240.
- 14 F. Wearing Surface: Hammered.
- 15 G. Thickness: 0.14-inches - 3.5 mm.
- 16 H. Size: 610 by 610 mm.

17 2.2 INSTALLATION MATERIALS

- 18 A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- 19 B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
 - 20 1. Verify adhesives have a VOC content of 50 g/L or less.
 - 21 2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

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27 PART 3 - EXECUTION

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30 3.1 EXAMINATION

- 31 A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 32 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- 33 B. Proceed with installation only after unsatisfactory conditions have been corrected.

34
35
36 3.2 PREPARATION

- 37 A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- 38 B. Concrete Substrates: Prepare according to ASTM F710.
 - 39 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 40 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 41 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
 - 42 4. Moisture Testing: Perform tests so that each test area does not exceed 1,000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - 43 a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - 44 b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- 45 C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- 46 D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 47 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

- 1 E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.
- 2 3.3 FLOOR TILE INSTALLATION
- 3 A. Comply with manufacturer's written instructions for installing floor tile.
- 4 B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite
- 5 edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at
- 6 perimeter.
- 7 1. Lay tiles square with room axis.
- 8 C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and
- 9 packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- 10 1. Lay tiles with grain running in one direction.
- 11 D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in
- 12 furniture, cabinets, pipes, outlets, and door frames.
- 13 E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door
- 14 openings.
- 15 F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on
- 16 floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- 17 G. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed
- 18 installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks,
- 19 and other surface imperfections.
- 20 3.4 CLEANING AND PROTECTION
- 21 A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- 22 B. Perform the following operations immediately after completing floor tile installation:
- 23 1. Remove adhesive and other blemishes from surfaces.
- 24 2. Sweep and vacuum surfaces thoroughly.
- 25 3. Damp-mop surfaces to remove marks and soil.
- 26 C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of
- 27 equipment and fixtures during remainder of construction period.
- 28 D. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile
- 29 surfaces before applying liquid cleaners, sealers, and finish products.
- 30 1. Apply number of coats recommended by manufacture.
- 31 E. Cover floor tile until Substantial Completion.

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END OF SECTION

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SECTION 09 68 13
TILE CARPETING

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17 3.3 INSTALLATION 3
18 3.4 CLEANING AND PROTECTION 3
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20 PART 1 – GENERAL
21
22 1.1 SUMMARY
23 A. Section Includes:
24 1. Modular carpet tile.
25 B. Related Requirements:
26 1. Section 024119 "Selective Demolition" for removing existing floor coverings.
27 2. Section 096513 "Resilient Base and Accessories"
28 3. Section 096519 "Resilient Tile Flooring" for resilient wall base and accessories installed with carpet tile.
29 1.2 SUBMITTALS
30 A. Product Data: For each type of product.
31 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
32 2. Include manufacturer's written installation recommendations for each type of substrate.
33 B. Sustainable Design Submittals:
34 1. Product Data: For adhesives, indicating VOC content.
35 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting
36 materials.
37 3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting
38 materials.
39 C. Samples: For each of the following products and for each color and texture required. Label each Sample with
40 manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
41 1. Carpet Tile: Full-size Sample.
42 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
43 D. Qualification Data: For Installer.
44 E. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
45 F. Sample Warranty: For special warranty.
46 G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
47 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and
48 manufacturer's recommended maintenance schedule.
49 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
50 1.3 DELIVERY, STORAGE, AND HANDLING
51 A. Comply with the Carpet and Rug Institute's CRI 104.
52 1.4 FIELD CONDITIONS
53 A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
54 B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-
55 work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels
56 planned for building occupants during the remainder of the construction period.
57 C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive
58 and concrete slabs have pH range recommended by carpet tile manufacturer.

- 1 D. Where items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.
2 1.5 WARRANTY
3 A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation
4 that fail in materials or workmanship within specified warranty period.
5 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate,
6 vandalism, or abuse.
7 2. Failures include, but are not limited to, the following:
8 a. More than 10 percent edge raveling, snags, and runs.
9 b. Dimensional instability.
10 c. Excess static discharge.
11 d. Loss of tuft-bind strength.
12 e. Loss of face fiber.
13 f. Delamination.
14 3. Warranty Period: Lifetime.

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16 PART 2 - PRODUCTS
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19 2.1 CARPET TILE (CPT-1)

- 20 A. Manufacture: J+J Flooring.
21 B. Product: Kinetix
22 C. Color: 1859 Digital.
23 D. Pattern: Quarter turn.
24 E. Total Weight: 4.5 – 5.2 oz/sq ft.
25 F. Backing: Manufacturer's standard Nexus modular.
26 G. Size: 24 by 24 inches.
27 H. Sustainable Design Requirements:
28 1. Verify flooring products comply with the requirements of the California Department of Public Health's
29 "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor
30 Sources Using Environmental Chambers."

31 2.2 CARPET TILE (WM-1)

- 32 A. Manufacture: J+J Flooring.
33 B. Product: Incognito
34 C. Color: 1841 Intelligence.
35 D. Pattern: Quarter turn.
36 E. Fiber type: Encore SD with recycled content.
37 F. Pile Density: 8,717 oz./cu. yd.
38 G. Face Weight: 29 oz/sq yd.
39 H. Backing: Manufacturer's standard Nexus modular.
40 I. Size: 24 by 24 inches.
41 J. Sustainable Design Requirements:
42 1. Verify flooring products comply with the requirements of the California Department of Public Health's
43 "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor
44 Sources Using Environmental Chambers."

45 2.3 INSTALLATION ACCESSORIES

- 46 A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or
47 recommended by carpet tile manufacturer.
48 B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor
49 conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by
50 carpet tile manufacturer for releasable installation.
51 1. Verify adhesives have a VOC content of 50 g/L or less.
52 2. Verify adhesive complies with the testing and product requirements of the California Department of Public
53 Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from
54 Indoor Sources Using Environmental Chambers."
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1 PART 3 - EXECUTION

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3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

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**SECTION 09 91 14
EXTERIOR PAINTING**

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23 PART 1 – GENERAL

- 24
25 1.1 SUMMARY
26 A. Section Includes:
27 1. Surface preparation and application of paint systems on exterior substrates.
28 a. Concrete.
29 b. Steel and iron.
30 c. Galvanized metal.
31 B. Related Requirements:
32 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates.
33 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
34 1.2 DEFINITIONS
35 A. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
36 B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
37 C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
38 D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
39 1.3 SUBMITTALS
40 A. Product Data: For each type of product.
41 1. Include preparation requirements and application instructions.
42 2. Include printout of current "MPI Approved Products List" for each product category specified, with the
43 proposed product highlighted.
44 3. Indicate VOC content.
45 B. Sustainable Design Submittals:
46 1. Product Data: For paints and coatings, indicating VOC content.
47 2. Environmental Product Declaration (EPD): For each product.
48 3. Health Product Declaration (HPD): For each product.
49 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
50 5. Manufacturer Inventory: For each product, provide manufacturer's manifest of ingredients.
51 C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
52 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
53 2. Apply coats on Samples in steps to show each coat required for system.
54 3. Label each coat of each Sample.
55 4. Label each Sample for location and application area.
56 D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on
57 Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include
58 color designations.

- 1 1.4 MAINTENANCE MATERIAL SUBMITTALS
- 2 A. Furnish extra materials that match products installed and that are packaged with protective covering for storage
- 3 and identified with labels describing contents.
- 4 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.
- 5 1.5 QUALITY ASSURANCE
- 6 A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections
- 7 made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and
- 8 execution.
- 9 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
- 10 a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
- 11 b. Other Items: Architect will designate items or areas required.
- 12 2. Final approval of color selections will be based on mockups.
- 13 a. If preliminary color selections are not approved, apply additional mockups of additional colors
- 14 selected by Architect at no added cost to Owner.
- 15 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
- 16 mockups unless Architect specifically approves such deviations in writing.
- 17 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if
- 18 undisturbed at time of Substantial Completion.
- 19 1.6 DELIVERY, STORAGE, AND HANDLING
- 20 A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures
- 21 continuously maintained at not less than 45 deg F (7 deg C).
- 22 1. Maintain containers in clean condition, free of foreign materials and residue.
- 23 2. Remove rags and waste from storage areas daily.
- 24 1.7 FIELD CONDITIONS
- 25 A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and
- 26 95 deg F (10 and 35 deg C).
- 27 B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less
- 28 than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
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- 30 PART 2 - PRODUCTS
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- 32
- 33 2.1 MANUFACTURERS
- 34 A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work
- 35 include, but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.
- 36 B. Source Limitations: Obtain paint from single source from single manufacturer.
- 37 2.2 PAINT PRODUCTS
- 38 A. MPI Standards: Provide products complying with MPI standards indicated and listed in its "MPI Approved Products
- 39 List."
- 40 B. Material Compatibility:
- 41 1. Provide materials for use within each paint system that are compatible with one another and substrates
- 42 indicated, under conditions of service and application as demonstrated by manufacturer, based on testing
- 43 and field experience.
- 44 2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturers for
- 45 use in paint system and on substrate indicated.
- 46 C. VOC Content: For field applications, verify paints and coatings comply with VOC content limits of authorities having
- 47 jurisdiction and the following VOC content limits:
- 48 1. Flat Paints and Coatings: 50 g/L.
- 49 2. Nonflat Paints and Coatings: 50 g/L.
- 50 3. Dry-Fog Coatings: 150 g/L.
- 51 4. Primers, Sealers, and Undercoaters: 100 g/L.
- 52 5. Rust-Preventive Coatings: 100 g/L.
- 53 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
- 54 7. Pretreatment Wash Primers: 420 g/L.
- 55 8. Shellacs, Clear: 730 g/L.
- 56 9. Shellacs, Pigmented: 550 g/L.
- 57 D. Colors: As indicated in a color schedule
- 58

1 PART 3 - EXECUTION

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4 3.1 EXAMINATION

- 5 A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum
6 moisture content and other conditions affecting performance of the Work.
7 B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
8 1. Concrete: 12 percent.
9 2. Masonry (Clay and CMUs): 12 percent.
10 C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
11 D. Proceed with coating application only after unsatisfactory conditions have been corrected.
12 1. Application of coating indicates acceptance of surfaces and conditions.

13 3.2 PREPARATION

- 14 A. Comply with manufacturer's written instructions and recommendations in "MPI Maintenance Repainting Manual"
15 applicable to substrates and paint systems indicated.
16 B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If
17 removal is impractical or impossible because of size or weight of item, provide surface-applied protection before
18 surface preparation and painting.
19 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were
20 removed. Remove surface-applied protection.
21 C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible
22 paints and encapsulants.
23 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required
24 to produce paint systems indicated.
25 D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if
26 moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written
27 instructions.
28 E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of
29 surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
30 F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in
31 writing by paint manufacturer but not less than the following:
32 1. SSPC-SP 6/NACE No. 3 is allowed by authorities having jurisdiction and the Owner.
33 2. SSPC-SP 7/NACE No. 4.
34 G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint
35 exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-
36 primed surfaces.
37 H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods
38 to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

39 3.3 INSTALLATION

- 40 A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Manual."
41 1. Use applicators and techniques suited for paint and substrate indicated.
42 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint
43 surfaces behind permanently fixed items with prime coat only.
44 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
45 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance
46 rating, or nomenclature plates.
47 5. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or
48 factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and
49 topcoat paint manufacturers.
50 B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint
51 finish, color, and appearance.
52 C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs,
53 sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

54 3.4 FIELD QUALITY CONTROL

- 55 A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect
56 and test paint for dry film thickness.
57 1. Contractor shall touch up and restore painted surfaces damaged by testing.

1 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's
2 written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry
3 film thickness that complies with paint manufacturer's written instructions.

4 3.5 CLEANING AND PROTECTION

- 5 A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- 6 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other
7 contaminants from entering into waterways, sanitary and storm drain systems, and ground.
- 8 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
- 9 3. Allow empty paint cans to dry before disposal.
- 10 4. Collect waste paint by type and deliver to recycling or collection facility.
- 11 B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or
12 other methods. Do not scratch or damage adjacent finished surfaces.
- 13 C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by
14 cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- 15 D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

16 3.6 EXTERIOR PAINTING SCHEDULE

- 17 A. Concrete Substrates, Nontraffic Surfaces:
- 18 1. Latex System MPI EXT 3.1A:
19 a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
20 b. Low-Sheen Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15
- 21 B. Steel Substrates:
- 22 1. Quick-Dry Enamel System MPI EXT 5.1A:
23 a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
24 b. Semigloss Topcoat: Alkyd, quick dry, semigloss (MPI Gloss Level 5), MPI #81.
- 25 C. Galvanized-Metal Substrates:
- 26 1. Latex System MPI EXT 5.3H:
27 a. Water-Based Prime Coat: Primer, galvanized, water based, MPI #134.
28 b. Semigloss Topcoat: Latex, exterior, semigloss (MPI Gloss Level 5), MPI #11.

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END OF SECTION

**SECTION 09 91 24
INTERIOR PAINTING**

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22

23 PART 1 – GENERAL

- 24
25 1.1 SUMMARY
26 A. Section includes surface preparation and the application of paint systems on interior substrates.
27 1. Concrete.
28 2. Concrete masonry units (CMUs).
29 3. Steel and iron.
30 4. Galvanized metal.
31 5. Gypsum board.
32 B. Related Requirements:
33 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
34 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
35 1.2 DEFINITIONS
36 A. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
37 B. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
38 1.3 SUBMITTALS
39 A. Product Data: For each type of product. Include preparation requirements and application instructions.
40 1. Include printout of current "MPI Approved Products List" for each product category specified, with the
41 proposed product highlighted.
42 2. Indicate VOC content.
43 B. Sustainable Design Submittals:
44 1. Product Data: For paints and coatings, indicating VOC content.
45 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting
46 materials.
47 3. Environmental Product Declaration: For each product.
48 4. Health Product Declaration: For each product.
49 5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
50 6. Manufacturer Inventory: For each product, provide manufacturer's manifest of ingredients.
51 C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
52 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
53 2. Apply coats on Samples in steps to show each coat required for system.
54 3. Label each coat of each Sample.
55 4. Label each Sample for location and application area.
56 D. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference
57 paint systems specified in this Section. Include color designations.

- 1 1.4 MAINTENANCE MATERIAL SUBMITTALS
2 A. Furnish extra materials that match products installed and that are packaged with protective covering for storage
3 and identified with labels describing contents.
4 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.
5 1.5 QUALITY ASSURANCE
6 A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary
7 selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for
8 materials and execution.
9 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
10 a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
11 b. Other Items: Architect will designate items or areas required.
12 2. Final approval of color selections will be based on mockups.
13 a. If preliminary color selections are not approved, apply additional mockups of additional colors
14 selected by Architect at no added cost to Owner.
15 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
16 mockups unless Architect specifically approves such deviations in writing.
17 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if
18 undisturbed at time of Substantial Completion.
19 1.6 DELIVERY, STORAGE, AND HANDLING
20 A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures
21 continuously maintained at not less than 45 deg F (7 deg C).
22 1. Maintain containers in clean condition, free of foreign materials and residue.
23 2. Remove rags and waste from storage areas daily.
24 1.7 FIELD CONDITIONS
25 A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and
26 95 deg F (10 and 35 deg C).
27 B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F (3 deg C)
28 above the dew point; or to damp or wet surfaces.
29
30 PART 2 - PRODUCTS
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33 2.1 MANUFACTURERS
34 A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work
35 include, but are not limited to products]listed in the Interior Painting Schedule for the paint category indicated.
36 2.2 PAINT, GENERAL
37 A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved
38 Products List."
39 B. Material Compatibility:
40 1. Materials for use within each paint system shall be compatible with one another and substrates indicated,
41 under conditions of service and application as demonstrated by manufacturer, based on testing and field
42 experience.
43 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for
44 use in paint system and on substrate indicated.
45 C. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply
46 with VOC content limits of authorities having jurisdiction and the following VOC content limits:
47 1. Flat Paints and Coatings: 50 g/L.
48 2. Nonflat Paints and Coatings: 50 g/L.
49 3. Dry-Fog Coatings: 150 g/L.
50 4. Primers, Sealers, and Undercoaters: 100 g/L.
51 5. Rust-Preventive Coatings: 100 g/L.
52 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
53 7. Pretreatment Wash Primers: 420 g/L.
54 8. Shellacs, Clear: 730 g/L.
55 9. Shellacs, Pigmented: 550 g/L.
56 D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, verify 90 percent of
57 paints and coatings comply with the requirements of the California Department of Public Health's "Standard

1 Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using
2 Environmental Chambers."

3 E. Colors: As indicated in a color schedule.

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5 PART 3 - EXECUTION

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8 3.1 EXAMINATION

9 A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum
10 moisture content and other conditions affecting performance of the Work.

11 B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

12 1. Concrete: 12 percent.

13 2. Masonry (Clay and CMUs): 12 percent.

14 3. Gypsum Board: 12 percent.

15 C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

16 D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

17 E. Proceed with coating application only after unsatisfactory conditions have been corrected.

18 1. Application of coating indicates acceptance of surfaces and conditions.

19 3.2 PREPARATION

20 A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification
21 Manual" and "MPI Maintenance Repainting Manual" applicable to substrates and paint systems indicated.

22 B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If
23 removal is impractical or impossible because of size or weight of item, provide surface-applied protection before
24 surface preparation and painting.

25 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were
26 removed. Remove surface-applied protection if any.

27 C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible
28 paints and encapsulants.

29 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required
30 to produce paint systems indicated.

31 D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if
32 moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written
33 instructions.

34 1. Clean surfaces with pressurized water. Use pressure range needed to remove unwanted material. If water
35 does not create workable solution, then abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.

36 E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of
37 surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

38 1. Clean surfaces with pressurized water. Use pressure range needed to remove unwanted material.

39 F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in
40 writing by paint manufacturer but not less than the following:

41 1. SSPC-SP 2.

42 2. SSPC-SP 3.

43 G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint
44 exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-
45 primed surfaces.

46 H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods
47 to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

48 3.3 INSTALLATION

49 A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

50 1. Use applicators and techniques suited for paint and substrate indicated.

51 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final
52 installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

53 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match
54 exposed surfaces.

55 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance
56 rating, or nomenclature plates.

57 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished
58 if acceptable to topcoat manufacturers.

- 1 B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint
- 2 finish, color, and appearance.
- 3 C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs,
- 4 sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- 5 3.4 FIELD QUALITY CONTROL
- 6 A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect
- 7 and test paint for dry-film thickness.
- 8 1. Contractor shall touch up and restore painted surfaces damaged by testing.
- 9 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's
- 10 written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide
- 11 dry-film thickness that complies with paint manufacturer's written recommendations.
- 12 3.5 CLEANING AND PROTECTION
- 13 A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- 14 B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or
- 15 other methods. Do not scratch or damage adjacent finished surfaces.
- 16 C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by
- 17 cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- 18 D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
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- 1 3.6 INTERIOR PAINTING SCHEDULE
2 A. Concrete Substrates, Vertical Surfaces (Service Lane):
3 1. Epoxy-Modified Latex System **MPI EXT 3.1E**:
4 a. Prime Coat: Sherwin Williams Pro Industrial Heavy Duty Block filler.
5 b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
6 c. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), **MPI #115**.
7 1) Sherwin Williams Pro Industrial Water Based Catalyzed Epoxy.
8 B. Concrete Substrates, Nontraffic Surfaces:
9 1. Institutional Low-Odor/VOC Latex System, MPI INT 3.1M]
10 a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
11 b. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
12 C. CMU Substrates:
13 1. Institutional Low-Odor/VOC Latex System, MPI INT 4.2E:
14 a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
15 b. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
16 D. CMU Substrates (Service Lane):
17 1. Epoxy-Modified Latex System **MPI EXT 3.1E**:
18 a. Prime Coat: Sherwin Williams Pro Industrial Heavy Duty Block filler.
19 b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
20 c. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), **MPI #115**.
21 1) Sherwin Williams Pro Industrial Water Based Catalyzed Epoxy.
22 E. Steel Substrates (Service Lane):
23 1. Epoxy-Modified Latex System **MPI EXT 3.1E**:
24 a. Prime Coat: Sherwin Williams Pro Industrial Heavy Duty Block filler.
25 b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
26 c. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), **MPI #115**.
27 1) Sherwin Williams Pro Industrial Water Based Catalyzed Epoxy.
28 F. Steel Substrates:
29 1. Alkyd System, MPI INT 5.1EE:
30 a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
31 b. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level 5), MPI #47.
32 G. Galvanized-Metal Substrates:
33 1. Alkyd over Cementitious Primer System, MPI INT 5.3C:
34 a. Prime Coat: Primer, galvanized, cementitious, MPI #26.
35 b. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level 5), MPI #47.
36 H. Gypsum Board Substrates:
37 1. Institutional Low-Odor/VOC Latex System, MPI INT 9.2M:
38 a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
39 b. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
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END OF SECTION

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**SECTION 10 14 23
 PANEL SIGNAGE**

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 19 3.2 INSTALLATION 3
 20 3.3 ADJUSTING AND CLEANING 3

21
 22 PART 1 – GENERAL
 23
 24 1.1 SUMMARY
 25 A. Section includes:
 26 1. Panel signs.
 27 1.2 DEFINITIONS
 28 A. Accessible: In accordance with the accessibility standard.
 29 1.3 COORDINATION
 30 A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other
 31 installers.
 32 1.4 SUBMITTALS
 33 A. Product Data:
 34 1. Panel signs.
 35 B. Sustainable Design Submittals:
 36 1. **Product Data**: For adhesives, indicating VOC content.
 37 2. **Laboratory Test Reports**: For adhesives, indicating compliance with requirements for low-emitting
 38 materials.
 39 C. Shop Drawings: For panel signs.
 40 1. Include fabrication and installation details and attachments to other work.
 41 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and
 42 accessories.
 43 3. Show message list, typestyles, graphic elements, **including raised characters and Braille**, and layout for
 44 each sign at least **half size**.
 45 D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 46 1. Include representative Samples of available typestyles and graphic symbols.
 47 E. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.
 48 F. Qualification Data: For **manufacturer**.
 49 G. Sample Warranty: For special warranty.
 50 H. Maintenance Data: For signs to include in maintenance manuals.
 51 1.5 WARRANTY
 52 A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or
 53 workmanship within specified warranty period.
 54 1. Failures include, but are not limited to, the following:
 55 a. Deterioration of finishes beyond normal weathering.
 56 b. Deterioration of embedded graphic image.
 57 c. Separation or delamination of sheet materials and components.
 58 2. Warranty Period: **Five** years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in **the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.**

2.2 PANEL SIGNS

A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Integral Tactile Plaque: Graphics and Plaque materials are one piece. Tactile Photopolymer Inserts are .080" phenolic photopolymer with raised copy and fully domed Grade 2 Braille dots etched to 1/32". Background color is painted in acrylic lacquer in the specified Insert color. Top surface of copy characters is then added by roller printing in specified copy color using Silkscreen inks.
2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition:
 - 1) Vertical Edges: **Square cut.**
 - 2) Horizontal Edges: **Square cut.**
 - b. Corner Condition in Elevation: **Square.**
3. Mounting: **Surface mounted to wall with adhesive and/or two-face tape.**
4. Color **as selected by Architect from full range of industry colors.**
 - a. Painted Finish and Graphics: Manufacturer's standard, factory-applied **acrylic lacquer**, in color **as selected by Architect from manufacturer's full range.**
5. Text and Typeface: **Accessible raised characters and Braille. Typeface matching Architect's schedule. Finish raised characters to contrast with background color, and finish Braille to match background color.**
6. Flatness Tolerance: Sign is to remain flat under installed conditions within a tolerance of plus or minus **1/16 inch** measured diagonally from corner to corner.

2.3 PANEL-SIGN MATERIALS

A. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated. Fade resistant to 5 years.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
- B. Adhesive: As recommended by sign manufacturer.
 1. Verify adhesives have a VOC content of **70 g/L** or less.
 2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, **0.045 inch (1.14 mm)** thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
- B. Design components allow for expansion and contraction for a minimum material temperature range of 100 degrees F, without causing buckling or over stressing of adhesives and fasteners.
- C. Form work to required shapes and sizes, with true lines and angles. Provide necessary rebates, lugs, and brackets for assembly of units.
- D. Contact surfaces of connected members must be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces should be smooth, flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus .032". Restore texture to filled or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angels and smooth surfaces.
- G. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Parts are checked for approval against the color match master chip. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter, and other imperfections.

- 1 2.6 GENERAL FINISH REQUIREMENTS
2 A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
3 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
4 installed to minimize contrast.
5

6 PART 3 - EXECUTION
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8

9 3.1 EXAMINATION

- 10 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
11 tolerances and other conditions affecting performance of the Work.
12 B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities
13 between backs of signs and support surfaces unless otherwise indicated.
14 C. Proceed with installation only after unsatisfactory conditions have been corrected.

15 3.2 INSTALLATION

- 16 A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
17 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of
18 distortion and other defects in appearance.
19 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
20 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair
21 installation.
22 B. Accessible Signage: Install in locations on walls **as indicated on Drawings and according to the accessibility**
23 **standard.**
24 C. Mounting Methods:
25 1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear
26 beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign
27 after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied
28 and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive.
29 Temporarily support sign in position until adhesive fully sets.
30 2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape
31 strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage.
32 Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage
33 tape adhesive.
34 D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to
35 conceal back of sign and two-face tape.

36 3.3 ADJUSTING AND CLEANING

- 37 A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace
38 signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup
39 or similar minor repair procedures.
40 B. Remove temporary protective coverings and strippable films as signs are installed.
41 C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and
42 touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect
43 from damage until acceptance by Owner.
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END OF SECTION

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SECTION 10 14 43
WASH BAY CURTAIN AND TRACK

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5 1.1 SUMMARY 1
6 PART 2 - PRODUCTS 1
7 2.1 MANUFACTURERS: 1
8 2.2 FABRICATION: 2
9 PART 3 - EXECUTION 2
10 3.1 PREPARATION: 2
11 3.2 INSTALLATION: 2
12 3.3 ADJUSTING AND CLEANING: 2
13

14 PART 1 – GENERAL

15
16 1.1 SUMMARY

17 A. Section includes:

- 18 1. Wash bay curtain
19 2. Track
20 3. Hangers and accessories

21 B. SUBMITTALS:

- 22 1. Product Data: Manufacturer's and installation instructions.
23 2. Color Charts: Submit manufacturers color chart for reference by the Architect.
24 3. Shop Drawings: Show track layout, details and dimensions.
25 4. Product Certificates
26 5. Product warranty
27 6. Maintenance Data

28 C. JOB CONDITIONS:

- 29 1. Do not deliver materials until building is enclosed and ready for installation. Protect from damage during
30 delivery, handling, storage, and installation.
31

32 PART 2 - PRODUCTS

33
34
35 2.1 MANUFACTURERS:

36 A. Subject to compliance with the specifications, provide all products from one of the following manufacturers:

- 37 1. Akron
38 2. **AmCraft Manufacturing**
39 3. Approved equal.

40 B. MATERIALS:

- 41 1. Curtain:
42 a. Stationary, single, heavy duty industrial, non-staining composed of opaque vinyl coated polyester
43 reinforced with scrim.
44 b. NFPA Fire retardant meeting NFPA 701.
45 c. Edges and seams shall be fully hemmed and sealed
46 d. Double or triple hemed
47 e. Rated for temperatures between -25° F to 160° F
48 f. Color: As selected by the Architect from a minimum of 15 colors.
49 g. Provide grommets and attachments for a complete installation.
50 h. Curtain shall come with a 5 year warranty.

51 C. Track: Provide heavy duty, 16 gage, stainless steel, cold-rolled steel track, straight sections and accessories for a
52 complete installation.

- 53 1. Track: Heavy duty one-piece unit.
54 2. Track shall be installed with integral connections, free from rough edges and obstructions.
55 3. Track shall be suspended from existing structure and not attached to PVC ceiling..
56 4. Provide hangers and supports. Refer to the drawings for the dimensions, layout and configuration.
57 5. Where track hangs down below the support conditions, provide threaded rods. Do not use chains for
58 extended support.

- 1 6. All concealed materials shall be corrosion resistant, manufacturer's standard.
2 7. All exposed materials shall be stainless steel.
3 D. Provide all accessories and fasteners for a complete installation.
4 E. Track and curtain shall extend wall to wall.
5 2.2 FABRICATION:
6 A. Construction: Shop fabricate complete curtain and, to the extent possible, track and accessories.
7
8 PART 3 - EXECUTION
9
10
11 3.1 PREPARATION:
12 A. Field Measurements: Take field measurements prior to fabrication. Allow for adjustment of track and hangers.
13 B. Provide measurements so that the curtain is approximately 11-feet above finish floor, at its highest point. Ensure to
14 allow for any slopes in the floor elevation.
15 3.2 INSTALLATION:
16 A. Install units at locations shown, in accordance with manufacturer's instructions for plumb, level, rigid, and flush
17 installation. Provide reinforcing plates where necessary so that track is secure and rigid.
18 3.3 ADJUSTING AND CLEANING:
19 A. Adjust the complete unit so that the curtain operates in a smooth and reliable manner, as otherwise intended.
20
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END OF SECTION

**SECTION 10 21 13.19
PLASTIC TOILET COMPARTMENTS**

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12	2.3 SOLID-PLASTIC TOILET COMPARTMENTS.....		2
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15	2.6 FABRICATION		2
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18	3.2 INSTALLATION		3
19	3.3 ADJUSTING		3
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21	PART 1 – GENERAL		
22			
23	1.1 SUMMARY		
24	A. Section includes maintenance repainting as follows:		
25	1. Solid-plastic toilet compartments.		
26	B. Related Requirements:		
27	1. Section 061000 "Rough Carpentry" for blocking .		
28	2. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.		
29	1.2 COORDINATION		
30	A. Coordinate requirements for blocking, reinforcing, and other supports concealed within wall to ensure that toilet compartments can be supported and installed as indicated.		
31			
32	1.3 SUBMITTALS		
33	A. Product Data:		
34	1. Solid-plastic toilet compartments:		
35	a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.		
36			
37	B. Shop Drawings:		
38	1. Include plans, elevations, sections, details, and attachment details.		
39	2. Show locations of cutouts for compartment-mounted toilet accessories.		
40	3. Show locations of centerlines of toilet fixtures.		
41	4. Show locations of floor drains.		
42	5. Show overhead support or bracing locations.		
43	C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.		
44	1. Include Samples of hardware and accessories involving material and color selection.		
45	D. Sustainable Design Submittals:		
46	1. Product Data : For recycled content, indicating postconsumer and preconsumer recycled content and cost.		
47	E. Operation and Maintenance Data: For toilet compartments.		
48	1.4 FIELD CONDITIONS		
49	A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.		
50			
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53	PART 2 - PRODUCTS		
54			
55			
56	2.1 SOURCE LIMITATIONS		
57	A. Obtain plastic toilet compartments from single source from single manufacturer.		

- 1 2.2 PERFORMANCE REQUIREMENTS
- 2 A. **Recycled Content:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than
- 3 **<Insert value>** percent.
- 4 B. **Regional Materials:** Manufacture products within **100 miles (160 km)** of Project site from materials that have been
- 5 extracted, harvested, or recovered, as well as manufactured, within **100 miles (160 km)** of Project site.
- 6 C. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- 7 D. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the
- 8 following requirements:
- 9 1. Panels are able to withstand a concentrated load on grab bar of at least **250 lbf (1112 N)** applied at any
- 10 direction and at any point, without deformation of panel.
- 11 E. Regulatory Requirements: Comply with applicable provisions in **ICC A117.1** for toilet compartments designated as
- 12 accessible.
- 13 2.3 SOLID-PLASTIC TOILET COMPARTMENTS
- 14 A. Toilet-Enclosure Style: **Floor anchored.**
- 15 B. Urinal-Screen Style: **Wall hung.**
- 16 C. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) material, not less than **1 inch (25**
- 17 **mm)** thick, seamless, with eased edges, and with homogenous color throughout thickness of material.
- 18 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
- 19 2. Heat-Sink Strip: Manufacturer's continuous, **extruded-aluminum** strip fastened to exposed bottom edges of
- 20 solid-plastic components to hinder malicious combustion.
- 21 3. Color: **One color** in each room **as selected by Architect from manufacturer's full range.**
- 22 D. Urinal-Screen Construction: Matching panel construction.
- 23 E. Pilaster Shoes: Manufacturer's standard design; **stainless steel.**
- 24 F. Pilaster Sleeves (Caps): Manufacturer's standard design; **stainless steel.**
- 25 G. Brackets (Fittings):
- 26 1. Full-Height (Continuous) Type: Manufacturer's standard design; **extruded aluminum or stainless steel.**
- 27 2.4 HARDWARE AND ACCESSORIES
- 28 A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories.
- 29 1. Hinges:
- 30 a. Manufacturer's **continuous, cam type that swings to a closed or partially open position**, allowing
- 31 emergency access by lifting door.
- 32 1) Material, Continuous Hinge: **Stainless steel.**
- 33 2. Latch and Keeper: Manufacturer's surface-mounted latch unit, designed for emergency access, and with
- 34 combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements
- 35 for accessibility at toilet enclosures designated as accessible.
- 36 a. Material: **Stainless steel.**
- 37 3. Coat Hook: Manufacturer's combination hook and rubber-tipped bumper, sized to prevent inswinging door
- 38 from hitting compartment-mounted accessories.
- 39 a. Material: **Stainless steel.**
- 40 4. Door Bumper: Manufacturer's rubber-tipped bumper at outswinging doors.
- 41 a. Material: **Stainless steel.**
- 42 5. Door Pull: Manufacturer's unit at outswinging doors that complies with regulatory requirements for
- 43 accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
- 44 a. Material: **Stainless steel.**
- 45 B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items
- 46 they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For
- 47 concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel
- 48 compatible with related materials.
- 49 2.5 MATERIALS
- 50 A. Aluminum Castings: ASTM B26/B26M.
- 51 B. Aluminum Extrusions: **ASTM B221 (ASTM B221M).**
- 52 C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- 53 D. Stainless Steel Castings: ASTM A743/A743M.
- 54 2.6 FABRICATION
- 55 A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for
- 56 through-partition toilet accessories where required for attachment of toilet accessories.

- 1 B. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with
- 2 leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal
- 3 anchorage.
- 4 C. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at walls.
- 5 D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard
- 6 toilet enclosures and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear
- 7 opening for toilet enclosures designated as accessible.
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9 PART 3 - EXECUTION

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3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels or Screens: 1/2 inch (13 mm).
 - b. Panels or Screens and Walls: 1 inch (25 mm).
 - 2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust, so tops of doors are level with tops of pilasters when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION

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**SECTION 10 26 00
 WALL PROTECTION**

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 24
 25 1.1 SUMMARY
 26 A. Section includes
 27 1. Corner guards.
 28 B. Related Requirements:
 29 1. **Section 087100 "Door Hardware"** for metal protective trim units, according to BHMA A156.6, used for
 30 armor, kick, mop, and push plates.
 31 1.2 SUBMITTALS
 32 A. Product Data: For each type of product.
 33 1. Include construction details, material descriptions, impact strength, dimensions of individual components
 34 and profiles, and finishes.
 35 B. Sustainable Design Submittals:
 36 1. [Chain-of-Custody Qualification Data](#): For manufacturer and vendor.
 37 2. [Product Data](#): For adhesives, indicating VOC content.
 38 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting
 39 materials.
 40 C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and
 41 texture specified.
 42 1. Include Samples of accent strips and accessories to verify color selection.
 43 D. Product Certificates: For each type of handrail.
 44 E. Material Certificates: For each type of exposed plastic material.
 45 F. Sample Warranty: For special warranty.
 46 G. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 47 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic
 48 covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and
 49 methods that may be detrimental to finishes and performance.
 50 1.3 QUALITY ASSURANCE
 51 A. [Vendor Qualifications](#): A vendor that is certified for chain of custody by an FSC-accredited certification body.
 52 1.4 DELIVERY, STORAGE, AND HANDLING
 53 A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected
 54 from weather, moisture, soiling, extreme temperatures, and humidity.
 55 1. Maintain room temperature within storage area at not less than **70 deg F (21 deg C)** during the period
 56 plastic materials are stored.
 57 2. Keep plastic materials out of direct sunlight.

- 1 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material
2 attains a minimum room temperature of **70 deg F (21 deg C)**.
3 a. Store corner-guard covers in a vertical position.

4 1.5 WARRANTY

- 5 A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail
6 in materials or workmanship within specified warranty period.
7 1. Failures include, but are not limited to, the following:
8 a. Structural failures including detachment of components from each other or from the substrates,
9 delamination, and permanent deformation beyond normal use.
10 b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
11 2. Warranty Period: **Five** years from date of Substantial Completion.

12
13 PART 2 - PRODUCTS

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15
16 2.1 MANUFACTURERS

- 17 A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

18 2.2 PERFORMANCE REQUIREMENTS

- 19 A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify
20 products with appropriate markings of applicable testing agency.
21 1. Flame-Spread Index: 25 or less.
22 2. Smoke-Developed Index: 450 or less.

23 2.3 CORNER GUARDS (CG-1)

- 24 A. Surface-Mounted, Opaque-Plastic Corner Guards: Fabricated as one piece from **PVC-free plastic**; with formed
25 edges; fabricated with 90- or 135-degree turn to match wall condition.
26 1. Wing Size: Nominal 3/4 **inches**.
27 2. Thickness: 0.080 inches.
28 3. Height: Full height.
29 4. Mounting: **Adhesive**.
30 5. Color and Texture: **As selected by Architect from manufacturer's full range**.

31 2.4 MATERIALS

- 32 A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout;
33 extruded and sheet material as required, thickness as indicated.
34 B. Adhesive: As recommended by protection product manufacturer.
35 1. [Verify adhesives have a VOC](#) content of **70 g/L** or less.
36 2. [Verify adhesive complies with the](#) testing and product requirements of the California Department of Public
37 Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from
38 Indoor Sources Using Environmental Chambers."

39 2.5 FABRICATION

- 40 A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and
41 member sizes, including thicknesses of components.

42 2.6 FINISHES

- 43 A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before
44 shipping.
45 B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
46 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
47 installed to minimize contrast.

48
49 PART 3 - EXECUTION

50
51
52 3.1 EXAMINATION

- 53 A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation
54 tolerances and other conditions affecting performance of the Work.
55 B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that
56 have been installed in the locations required for secure attachment of support fasteners.
57 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates,
58 including compatibility with existing finishes or primers.

- 1 C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 2 3.2 PREPARATION
- 3 A. Complete finishing operations, including painting, before installing wall and door protection.
- 4 B. Before installation, clean substrate to remove dust, debris, and loose particles.
- 5 3.3 INSTALLATION
- 6 A. Installation Quality: Install wall protection according to manufacturer's written instructions, level, plumb, and true
- 7 to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be
- 8 visible in the finished Work.
- 9 B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a
- 10 complete installation.
- 11 1. Provide anchoring devices and suitable locations to withstand imposed loads.
- 12 3.4 CLEANING
- 13 A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based
- 14 household cleaning agent.
- 15 B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.
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END OF SECTION

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**SECTION 10 26 40
INDUSTRIAL FALL PROTECTION**

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19 3.2 ASSEMBLY 4
20 3.3 FIELD QUALITY CONTROL 5
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22 PART 1 – GENERAL
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24 1.1 SUMMARY
25 A. Section includes:
26 1. Custom engineered, Ceiling-Mounted Monorail Anchor Track System.
27 B. Related Requirements:
28 1. Section 05 50 00 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof
29 hatches.
30 1.2 REFERENCES
31 A. American Institute of Steel Construction (AISC): Manual of Steel Construction.
32 B. American National Standards Institute (ANSI) ANSI Z359: Fall Protection Code.
33 C. American Society for Testing and Materials (ASTM) A36: Carbon Structural Steel.
34 D. American Society for Testing and Materials (ASTM) B221: Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and
35 Tube.
36 E. American Society of Automotive Engineer (ASAE) J429: Grade 5.
37 F. American Welding Society (AWS) D1.1: Structural Welding Code .
38 G. Occupational Safety and Health Administration (OSHA)—Specification 1910.66: Personal Fall Arrest System.
39 1.3 DEFINITIONS
40 A. Standard Track Length: Track length is determined by the amount of actual working area needed, the fall hazard,
41 and by the length of the track from one end stop to the other.
42 B. Coverage Area: Linear coverage on the x-axis of up to 30 degrees off-center.
43 C. Working Capacity: All standard systems are designed for use with lanyards that limit the maximum average
44 arresting force to 900 pounds.
45 D. Overall Height: The overall height is measured at the highest point on system after installation.
46 E. Trolley-Hook Height: The trolley-hook height is measured by the distance from the ground to the underside of the
47 trolley hook.
48 F. Support Centers: Support Center is determined by the distance from the center of one ceiling support beam to next.
49 G. Overhang: Standard track overhangs are up to 18 inches from the center of a hanger location to the end of the
50 trussed track or up to 12 inches from a hanger location to the end of the plain track.
51 H. Construction: Fabricated using high-strength steel or ASTM A36 steel for structural components.
52 1.4 COORDINATION
53 A. Coordinate layout and installation of fall protection system with roof structure and ceiling mounted equipment.
54 B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
55 1.5 SUBMITTALS
56 A. Product Data:
57 1. Submit product data for system and all accessories.

- 1 2. Include construction details, material descriptions, dimensions of individual components and profiles, and
- 2 finishes.
- 3 3. Provide capacities, performance, standard use, and applied forces to system.
- 4 4. Manufacturer's assembly and operation instruction manual with included assembly drawings.
- 5 B. Shop Drawings:
- 6 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and
- 7 special conditions. Distinguish between plant- and field-assembled work.
- 8 2. Indicate size and location, method of attachment to structure, coordination with other systems and
- 9 required clearances.
- 10 C. Delegated-Design Submittal: Validate structure, mounting, and securing complies with the performance
- 11 requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer
- 12 responsible for their preparation.
- 13 1. Fall protection systems shall be designed by a Professional Engineer experienced in the design of fall
- 14 protection systems.
- 15 2. Fall protection systems shall be designed for use above metro transit bus by one user. Provide a single rail
- 16 above the length of the bus with the user on the rail.
- 17 3. Dynamic and dead load reactions shall be generated for all intermediate and end supports of the fall
- 18 protection system.
- 19 4. Design all fall protection systems to safely resist the dynamically applied loads while maintaining a safety
- 20 factor of two against failure.
- 21 5. Design of fall protection systems shall be based on the understanding that the underlying structural steel
- 22 supports are provided as part of the hangar and are adequate to support the imposed loads. Fall Protection
- 23 loads shall be furnished to the building design structural engineer of record.
- 24 6. Design Engineer shall prepare a fall clearance analysis verifying adequate fall distance to safely stop the
- 25 worker in the event of a fall.
- 26 7. Rail shall be designed for both workers falling at a time with full body harness and shock absorbing lifeline
- 27 with a maximum arresting force of 900 pounds per worker.
- 28 8. The systems shall be designed to be supported by and integral with the building. Each anchor location shall
- 29 be designed to support at least 5,000 pounds.
- 30 9. Design Engineer shall coordinate Fall Protection System with mechanical and electrical systems, lighting, fire
- 31 protection equipment and other components of the building.
- 32 10. System shall be designed in accordance with ANSI/ASSE Z 359.6 Specifications and Design Requirements for
- 33 Active Fall Protection Systems.
- 34 D. Sample Warranties: For manufacturer's special warranties.
- 35 E. Operation and Maintenance Data: For anchor track system to include in operation and maintenance manuals.
- 36 F. Manufacturer's Field Reports: Submit Letter of Certification from licensed design engineer indicating completion of
- 37 operational proof testing on installed system.
- 38 G. Training Owner's Employees: Submit list of attendees at training class in the use, care, and maintenance of fall
- 39 protection equipment.
- 40 1.6 QUALITY ASSURANCE
- 41 A. Standard system shall be designed, fabricated, and installed in accordance with ANSI Z359, OSHA 1910.66, and AISC.
- 42 B. Manufacturer's Qualifications: An ISO 9001:2015 registered company with more than 20 years of experience
- 43 successfully designing and manufacturing fall protection solutions.
- 44 C. Installer's Qualifications: A company that is acceptable to the manufacturer and meets OSHA requirements for a
- 45 Competent Person assembling and installing fall protection systems for multiple applications. Installer should be
- 46 able to:
- 47 1. Bolt connections in accordance with torque tightening procedures specified in AISC Manual, Part 5.
- 48 2. Clearly label system with maximum average arresting force visible from tie-off position.
- 49 1.7 PERFORMANCE REQUIREMENTS
- 50 A. Coverage: System shall provide linear coverage of size indicated on drawings and consist of:
- 51 1. Enclosed track.
- 52 2. Track hanger assemblies.
- 53 3. Swiveling connector Anchor Trolley.
- 54 B. Modular, Pre-Engineered Design: System shall be designed for one worker using single track.
- 55 1. System shall be designed, fabricated, and installed in accordance with ANSI Z359, OSHA 1910.66, and AISC
- 56 Manual of Steel Construction.
- 57 C. Design Strength: For one user, the system shall be designed based on a worst-case placement of the 900-pound
- 58 maximum average arresting force with a safety factor of two and the weight of the anchor system.

- 1 D. Operating Temperature: 5 to 200 degrees F
- 2 E. Structural Design: The system's structural design is based on dynamic load capacity. System shall be designed to
- 3 withstand:
- 4 1. System and dynamic load and impact factors.
- 5 2. Dynamic load capacity equal to rated capacity.
- 6 3. Inertia forces from the system and dynamic load movement.

7 1.8 CONDITIONS

- 8 A. Field Measurements: Verify field measurements and indicate measurements on Shop Drawings to ensure required
- 9 fit.
- 10 B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by
- 11 manufacturer for optimum results.
- 12 C. Do not install products under environmental conditions outside manufacturer's absolute limits.

13 1.9 DELIVERY, STORAGE, AND HANDLING

- 14 A. Store products in manufacturer's packaging until ready for installation.
- 15 B. Store and dispose of solvent-based materials in accordance with requirements of local authorities.

16 1.10 WARRANTY

- 17 A. Manufacturer's Warranty: Included on manufacturer's standard form and outlines the manufacturer's agreement to
- 18 repair or replace assemblies and components that fail in materials and/or execution within warranty period from
- 19 date of substantial completion.
- 20 1. Warranty covers the engineered track equipment, wearable end truck wheels, and anchor trolley wheels
- 21 and teeth to be free from defects in material and workmanship for a period of ten (10) years.

22
23 PART 2 - PRODUCTS

24
25
26 2.1 Ceiling-Mounted Monorail Anchor Track System

- 27 A. Manufacturers: Subject to compliance with requirements provide the following product or another comparable
- 28 product.
- 29 1. Rigid Lifelines, Morgantown, PA and Las Vegas, NV; Phone: 800-869-2080
- 30 2. Website: RigidLifelines.com
- 31 B. General:
- 32 1. Provide as a complete assembly including track, track hanger assemblies, track splice assemblies, drop rod
- 33 hanger assemblies, sway bracing, end stops, and connector trolley.
- 34 2. System Options
- 35 a. Individual track for use by one worker.
- 36 b. Provided with drop-rod type hanger assemblies that include adjustable beam clamps and drop rod
- 37 type hanger assemblies. The drop-rod type hanger assembly requires sway bracing. The existing
- 38 structure is pitched at approximately 0.5 / 12.0 with a gable peak at approximately mid-point of the
- 39 track.
- 40 3. Construction: Fabricated using high-strength steel or ASTM A36 steel for structural components.
- 41 C. Design Factors: Track, tubing, and welded track shall have a minimum yield strength of 46,000 pounds per square
- 42 inch. Track profile design shall provide wheel protection, accurate alignment with minimum friction, and low
- 43 maintenance, self-cleaning profile. All track shall have full contact flange loading surfaces (flat) to decrease flange
- 44 and wheel loads during a fall event.
- 45 D. Structure: Enclosed Anchor Track(s) bolted to existing structures with hanger assemblies.
- 46 1. Hanger assemblies: Includes hanger assemblies that provide a rigid connection for suspending tracks.
- 47 Assembly to consist of angle truss clamps and truss clamp plates. Use of threaded rods in flush hanger
- 48 assemblies not permitted.
- 49 2. Runways: Vertical truss fabricated from square steel tubes and enclosed steel track.
- 50 a. Track: Enclosed cold-formed steel track that serves as bottom cord of trussed track and permits
- 51 trolley(s) to ride on lower inside flanges. Fabricate lower running flanges with flat surface for higher
- 52 durability and wheel contact. Sloped flanges are not permitted.
- 53 b. Track splice: Includes truss splice plates and channel-shaped track splice joints for joining track
- 54 sections. Splice joints must be located within 48 inches of a support point.
- 55 c. Standard track cantilevers: Up to 18 inches of cantilever is allowed from a hanger location to the
- 56 end of the trussed track. Up to 12 inches of cantilever is allowed from a hanger location to the end
- 57 of the plain track. Longer track cantilevers are done on a customized basis.

- 1 3. Swiveling connector Anchor Trolley: Rigid-body trolley designed to ride inside enclosed track and to carry
2 load.
3 a. Construction: Steel body with two wheels on each side and positioning attachment point at center
4 of trolley so load weight is evenly distributed to trolley wheels.
5 b. Braking system: If at least 80 pounds of force, including the weight of the self-retracting lanyard, are
6 exerted on the swiveling connector, a series of eight hardened-alloy steel contact points create
7 friction against the enclosed track. The friction generated by the contact points, in conjunction with
8 the weight of the worker, causes the trolley to stop all movement on the track.
9 c. Wheels: Removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels
10 shall be flat to match track profile. Non-removable or tapered wheels are not acceptable. Provide
11 polyamide wheel material.
12 d. Designed for attachment of carabiner.
13 4. End stops: Molded composite resilient bumper installed in track to prevent end trucks from rolling out of
14 track. Bolt stops without energy absorbing bumper are not acceptable.
15 E. Accessories:
16 1. Cable Self-Retracting Lanyard: Provide one self-retracting lanyard for each track.
17 2. Housing: High Strength thermoplastic polymer
18 3. Cable Material: Galvanized steel wire roper – 3/16-inch diameter.
19 4. Working load capacity: 310 pounds.
20 5. Minimum capacity rating: 130 pounds.
21 6. Length: To be reviewed based on layout by manufacturer delegated design.
22 7. ANSI-rated steel swivel snap hook on lifeline end.
23 8. Installation carabiner for top
24 9. Meets ANSI 7359.11-2014, ANSI A10.32-2012, OSHA 1910, and OSHA 1926 Subpart M.
25 10. Bar joist mounting connections with drop rods and sloped hangers.
26 11. Beam clamp hangers
27 F. SHOP FINISHING
28 1. Standard Paint Colors:
29 a. All systems are painted with one coat of Yellow Industrial Enamel.
30 2. Surface Preparation and Painting Procedures:
31 a. Adhere to the standards of the Society for Protective Coatings (SSPC) for all product surface
32 preparation.
33 b. System components are deburred and descaled using power tools equipped with sanding discs and
34 wire wheels prior to painting.
35 c. Wash with high-pressure/high-temperature biodegradable degreaser solution.
36 d. Coat with quick drying semi-gloss enamel applied to a minimum dry-film thickness of two to three
37 mils.
38 e. Apply finishing coat with a hot airless electrostatic spray paint system.
39 f. Cure at air temperature.

40
41 PART 3 - EXECUTION
42

43
44 3.1 PREPARATION

- 45 A. Do not start assembly until support structures are properly prepared.
46 B. Inventory:
47 1. Check materials to ensure all parts are present.

48 3.2 ASSEMBLY

- 49 A. Units and accessories should be installed in accordance with manufacturer's Assembly and Operation Instructions
50 Manual.
51 B. Do not modify system components without manufacturer's approval.
52 C. Enclosed Track Installation
53 1. Raise track into position and clamp it to structure with beam clamp hangers.
54 2. Do not overhang ends of trussed tracks more than 48 inches beyond support centers.
55 D. Track Splice Installation (Application varies depending on required track length and support structure)
56 1. For systems with more than one section of track, an additional section is installed in the same manner, with
57 the addition of splice joint assembly.

- 1 2. The track splice joint is made using a sleeve. Slide sleeve over end of first track, and butt second track
2 against first. Center sleeve over joint. Tighten all top setscrews and side setscrews for correct track
3 alignment. Do not over tighten screws.
- 4 3. Track splice joints include two splice plates. Install splice plates to connect ends of truss top tubes. For
5 trussed track, splice joints should be within 48 inches of support hanger.
- 6 E. Swiveling Connector Anchor Trolley Installation
- 7 1. Install swiveling connector Anchor Trolley on track. Secure end stop bolts and rubber bumpers.
- 8 F. Final Assembly
- 9 1. Torque locknuts and bolts to appropriate specifications shown in manual.
- 10 2. After installation is complete, enclosed tracks should be leveled. Check tightness for all bolts and nuts.
- 11 3. This system must be used with an ANSI-rated self-retracting lanyard (SRL). Connect SRL and retrieval tagline
12 in accordance with manufacturer's specifications.
- 13 3.3 FIELD QUALITY CONTROL
- 14 A. Inspection.
- 15 1. Check that the beam clamps are installed horizontal within + / - five degrees.
- 16 2. Check that end stop bolts are present and have locknuts installed.
- 17 3. Using a torque wrench, check that all bolts are present and torqued to values shown on Assembly Drawing.
- 18 4. Check that splices, if supplied, are centered on track joints.
- 19 5. Verify that capacity labels are present, attached, and legible. Verify that the number of trolleys matches the
20 value on the capacity label.
- 21 6. Verify that the fall arrest system is not being used for material handling.
- 22 7. Check the track for levelness within + / - 1/4 inches per 20 feet of track.
- 23 8. Check the track flanges. Track flanges cannot be bent downward more than five degrees. Check the track
24 thickness. Track thickness cannot be worn more than 10 percent.
- 25 9. Check all system welds for cracks.
- 26 10. Check system components for corrosion and bent or damaged areas.
- 27 11. Check that all wheel studs, if supplied, are torqued to value shown on Assembly Drawing.
- 28 12. Verify trolley can traverse entire length of track without snags.
- 29 13. Check trolley for visibly bent swiveling connector, broken welds, or excessive wear or corrosion.
- 30 14. Test the operation of the trolley's swiveling connector and verify that it can rotate freely. Test the operation
31 of the trolley and verify the wheels rotate freely.
- 32 15. Check system components for loose components.
- 33 16. Check system components for loose or missing fasteners.
- 34 17. Check system support structure for stability.
- 35 18. Verify that hanger assemblies are installed properly and fasteners are torqued to proper values.
- 36 19. Check that the support arms pivot bolts, if supplied, are properly installed and tightened. Check system for
37 unauthorized modifications. Remove system from service if it is modified in any way.
- 38 B. Acceptance Inspection
- 39 1. After the system has been installed and after any modifications, an acceptance inspection must be
40 performed using the After a Fall Event and Annual Anchor Track System Inspection Checklist included in the
41 Assembly and Operation Instruction Manual before use. A qualified person or competent person must
42 perform acceptance inspections.
- 43 C. Maintenance
- 44 1. To keep systems in good operating order, engineers recommend establishing a regular schedule of
45 inspection and lubrication. All parts should be inspected, all loose parts adjusted, and worn parts replaced
46 at once.
- 47 2. Check track splices for alignment, and verify that Anchor Trolley travels smoothly through joints.
- 48 3. A Competent Person must perform an annual system inspection using the After a Fall Event and Annual
49 Anchor Track System Inspection Checklist included in the Assembly and Operation Instruction Manual.
- 50 D. Clean Surfaces
- 51 1. Touch up scratches and blemishes with matching paint from manufacturer.
- 52 2. Keep surfaces clean and clear of build-up and residue.
- 53 E. Protect System
- 54 1. Protect assembled products until completion of project.
- 55 2. Touch-up, repair, or replace damaged products before substantial completion.
- 56 F. Quality Standards
- 57 1. Welding performed during manufacturing process meets the American Welding Society's (AWS) D1.1
58 Standards.

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 - 7
2. System is manufactured to standards ensuring safety, reliability, and the highest quality.
 3. Products are manufactured in the United States of America
 4. Certify that all system components are in full compliance with the Buy American Clause of the American Recovery and Reinvestment Act (ARRA) of May 2009

END OF SECTION

**SECTION 10 28 00
TOILET AND BATH ACCESSORIES**

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19
20 PART 1 – GENERAL
21
22 1.1 SUMMARY
23 A. Section includes:
24 1. Bathroom accessories.
25 2. Shower room accessories.
26 3. Custodial accessories.
27 B. Related Requirements:
28 1. Section 088300 "Mirrors" for frameless mirrors.
29 1.2 COORDINATION
30 A. Coordinate accessory locations with other work to prevent interference with clearances required for access by
31 people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
32 B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
33 1.3 SUBMITTALS
34 A. Product Data:
35 1. Bathroom accessories.
36 2. Shower room accessories.
37 3. Custodial accessories.
38 B. Product Data Submittals: For each product.
39 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
40 finishes.
41 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and
42 substrate preparation.
43 3. Include electrical characteristics.
44 C. Sample Warranty: For manufacturer's special warranties.
45 D. Maintenance Data: For accessories to include in maintenance manuals.
46 1.4 WARRANTY
47 A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials
48 or workmanship within specified warranty period.
49 1. Failures include, but are not limited to, visible silver spoilage defects.
50 2. Warranty Period: **10** years from date of Substantial Completion.
51
52 PART 2 - PRODUCTS
53
54
55 2.1 OWNER-FURNISHED CONTRACTOR INSTALLED MATERIALS
56 A. Toilet Tissue (Roll) Dispenser TA-5
57 1. Manufacture: Tork.
58 2. Description: 3 roll dispenser.

- 1 3. Mounting: **Surface mounted.**
- 2 B. Paper Towel (Roll) Dispenser TA-6:
 - 3 1. Manufacture: Tork.
 - 4 2. Description: **Lever-actuated** mechanism that permits controlled delivery of paper rolls in preset lengths.
 - 5 3. Mounting: **Surface mounted.**
- 6 C. Soap Dispenser TA-7:
 - 7 1. Manufacture: GOJO.
 - 8 2. Description: Designed for manual operation and dispensing soap.
 - 9 3. Mounting: **Vertically oriented, surface mounted.**
- 10 2.2 PERFORMANCE REQUIREMENTS
- 11 A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 12 1. Grab Bars: Installed units are able to resist **250 lbf (1112 N)** concentrated load applied in any direction and
 - 13 at any point.
 - 14 2. Shower Seats: Installed units are able to resist **250 lbf** concentrated load applied in any direction and at any
 - 15 point.
- 16 2.3 BATHROOM ACCESSORIES (CONTRACTOR FURNISHED AND INSTALLED)
- 17 A. Source Limitations: Obtain bathroom **accessories** from single source from single manufacturer.
- 18 B. Grab Bar TA-1:
 - 19 1. Basis-of-Design Product: Bobrick B-6806.99.
 - 20 2. Mounting: Flanges with **concealed** fasteners.
 - 21 3. Material: Stainless steel, **0.05 inch (1.3 mm)** thick.
 - 22 a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).
 - 23 4. OD: **1-1/2 inches.**
 - 24 5. Configuration and Length: **As indicated on Drawings.**
- 25 C. Mirror Unit:
 - 26 1. Basis-of-Design Product: Bobrick B-165.
 - 27 2. Frame: **Stainless steel channel.**
 - 28 a. Corners: **Manufacturer's standard.**
 - 29 3. Size: 18 x 36.
 - 30 4. Hangers: **Manufacturer's standard rigid, tamper and theft resistant.**
- 31 D. Hook TA-3:
 - 32 1. Basis-of-Design Product: Bobrick B-683.
 - 33 2. Description: **Double-prong unit.**
 - 34 3. Mounting: **Concealed.**
 - 35 4. Material and Finish: **Stainless steel, ASTM A480/A480M No. 4 finish (satin).**
- 36 E. Sanitary Napkin Dispenser TA-TBD:
 - 37 1. Basis-of-Design Product: Bobrick B-270.
 - 38 2. Description: Surface-mounted sanitary napkin disposal shall be type-304 stainless steel with all-welded
 - 39 construction; exposed surfaces shall have satin finish. Cover shall be drawn, one-piece, seamless
 - 40 construction and secured to container with a full-length stainless steel piano-hinge. Container shall have
 - 41 integral finger depression for opening cover.
 - 42 3. Mounting: Surface.
 - 43 4. Material and Finish: **Stainless steel, ASTM A480/A480M No. 4 finish (satin).**
 - 44 5. Locations: 1 in each womens toilet rooms and 1 in each unisex toilet rooms. Locations TBD.
- 45 F. Waste Receptacle TA-TBD:
 - 46 1. Description: Floor standing waste receptacle with open top
 - 47 2. Capacity: 21-gallon.
 - 48 3. Locations: provide 1 in each toilet room.
- 49 G. Undersink Piping Covers:
 - 50 1. Basis-of-Design Product: IPS Corp Lav Guard 2.
 - 51 2. Description: Waste and supply piping covers satisfy ADA compliance requirements. Built-in internal
 - 52 fasteners and internal trimming feature allow for installation without tools. Designed to fit on all tubular
 - 53 and cast brass P-trap assemblies or schedule 40 ABS and PVC P-trap assemblies. Valve cover completely
 - 54 encloses angle valve and supply tube for both handled and keyed type water stops.
 - 55 3. Material and Finish: Molded from impact-resistant, stain resistant, antimicrobial vinyl. Smooth surface
 - 56 makes it easy to clean and maintain.
- 57 2.4 SHOWER ROOM ACCESSORIES
- 58 A. Source Limitations: Obtain **shower room accessories** from single source from single manufacturer.

- 1 B. Shower Curtain Rod TA-4:
2 1. Basis-of-Design Product: Bobrick B-6047.
3 2. Description: **1-1/4-inch**- OD, straight rod.
4 3. Configuration: **As indicated on Drawings**.
5 4. Mounting Flanges: **Concealed** fasteners; in **material and finish matching rod**.
6 5. Rod Material and Finish: **Stainless steel, ASTM A480/A480M No. 4 finish (satin)**.
7 C. Shower Curtain TA-4:
8 1. Size: Minimum **12 inches** wider than opening by **72 inches (1829 mm)** high.
9 2. Material: **Nylon-reinforced vinyl, minimum 9 oz. (255 g) or 0.008-inch- (0.2-mm-)** thick vinyl, with integral
10 **antibacterial and flame-retardant agents**.
11 3. Color: **White**.
12 4. Grommets: Corrosion resistant at minimum **6 inches (152 mm)** o.c. through top hem.
13 5. Shower Curtain Hooks: **Chrome-plated or stainless steel, spring wire curtain hooks with snap fasteners**,
14 sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
15 D. Portable Shower Seat TA-2:
16 1. Basis-of-Design Product: Access-Able Designs.
17 2. Frame: Type 304 Stainless Steel tube, 1-1/4" x 18ga. sq. mainframe with 1" x 18ga.
18 round cross members.
19 4. Leg: "H"-shaped yoke of type 304 Stainless Steel tubing, 1" x 18ga. round tubing, Heliarc welded to 1-1/4"
20 round x 12ga. frame hinge.
21 5. Seat: White finish Phenolic 1/2" x 3" slats bolted to frame with SS screws.
22 6. Configuration: **Rectangular seat**.
23 7. Dimensions: 30" x 16".
24 2.5 MATERIALS
25 A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, **0.031-inch- (0.8-mm-)** minimum nominal thickness
26 unless otherwise indicated.
27 B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or
28 ASTM B30, castings.
29 C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), **0.036-inch- (0.9-mm-)** minimum
30 nominal thickness.
31 D. Galvanized-Steel Sheet: ASTM A653/A653M, with **G60 (Z180)** hot-dip zinc coating.
32 E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
33 F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by
34 manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or
35 galvanized steel where concealed.
36 G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
37 H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
38 2.6 FABRICATION
39 A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with
40 full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
41
42 PART 3 - EXECUTION
43
44
45 3.1 INSTALLATION
46 A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate
47 indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and
48 at heights indicated.
49 1. Remove temporary labels and protective coatings.
50 B. Grab Bars: Install to comply with specified structural-performance requirements.
51 C. Shower Seats: Install to comply with specified structural-performance requirements.
52 3.2 ADJUSTING AND CLEANING
53 A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
54 B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.
55
56
57

END OF SECTION

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**SECTION 10 51 13
 METAL LOCKERS**

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 24
 25 PART 1 – GENERAL
 26
 27 1.1 SUMMARY
 28 A. Section includes:
 29 1. Welded corridor lockers.
 30 2. Locker benches.
 31 1.2 SUBMITTALS
 32 A. Product Data: For each type of product.
 33 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
 34 finishes for each type of metal locker **and bench**.
 35 B. Sustainable Design Submittals:
 36 1. [Product Data](#): For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 37 2. [Environmental Product Declaration](#): For each product.
 38 3. [Health Product Declaration](#): For each product.
 39 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 40 5. [Laboratory Test Reports](#): For composite wood products, indicating compliance with requirements for low-
 41 emitting materials.
 42 C. Shop Drawings: For metal lockers.
 43 1. Include plans, elevations, sections, and attachment details.
 44 2. Show locker trim and accessories.
 45 3. Include locker identification system and numbering sequence.
 46 D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.
 47 E. Sample Warranty: For special warranty.
 48 F. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in
 49 maintenance manuals.
 50 1.3 DELIVERY, STORAGE, AND HANDLING
 51 A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
 52 1.4 FIELD CONDITIONS
 53 A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.
 54 1.5 COORDINATION
 55 A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work
 56 specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

- 1 1.6 WARRANTY
2 A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or
3 workmanship, excluding finish, within specified warranty period.
4 1. Failures include, but are not limited to, the following:
5 a. Structural failures.
6 b. Faulty operation of latches and other door hardware.
7 2. Damage from deliberate destruction and vandalism is excluded.
8 3. Warranty Period for Welded Metal Lockers: **Lifetime** from date of Substantial Completion.
9 PART 2 - PRODUCTS
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11
12 2.1 MANUFACTURERS
13 A. Source Limitations: Obtain metal lockers, **locker benches**, and accessories from single source from single locker
14 manufacturer.
15 1. Obtain locks from single lock manufacturer.
16 2.2 PERFORMANCE REQUIREMENTS
17 A. Accessibility Standard: For lockers **and locker benches** indicated to be accessible, comply with applicable provisions
18 in the **USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1**.
19 2.3 WELDED CORRIDOR LOCKERS
20 A. Doors: One piece; fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet; formed into channel shape
21 with double bend at vertical edges and with right-angle single bend at horizontal edges.
22 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than **15**
23 **inches (381 mm)** wide; welded to inner face of doors.
24 2. Door Style: **Vented panel as follows**:
25 a. Louvered Vents: No fewer than **six louver openings at top and bottom for single-tier** lockers.
26 B. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses
27 as follows:
28 1. Tops, Bottoms, and Sides: **0.060-inch (1.52-mm)** nominal thickness.
29 2. Backs: **0.048-inch (1.21-mm)** nominal thickness.
30 3. Shelves: **0.060-inch (1.52-mm)** nominal thickness, with double bend at front and single bend at sides and
31 back.
32 C. Frames: Channel formed; fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet; lapped and factory
33 welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous,
34 integral, full-height door strikes on vertical main frames.
35 D. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that
36 are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
37 1. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
38 E. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not
39 protrude beyond door face; pry and vandal resistant.
40 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks;
41 positive automatic latching and prelocking.
42 a. Latch Hooks: Equip doors **48 inches (1219 mm)** and higher with three latch hooks and doors less
43 than **48 inches (1219 mm)** high with two latch hooks; fabricated from **0.120-inch (3.04-mm)**
44 nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each
45 latch hook.
46 b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving
47 components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that
48 allows locker door to be locked while door is open and then closed without unlocking or damaging
49 lock or latching mechanism.
50 F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped **aluminum** plates, with numbers and
51 letters at least **3/8 inch (9 mm)** high.
52 G. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
53 H. Continuous Zee Base: Fabricated from, **manufacturer's standard thickness, but not less than 0.060-inch** nominal-
54 thickness steel sheet.
55 1. Height: **4 inches**.
56 I. Continuous Sloping Tops: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet, with a pitch of
57 approximately 20 degrees.
58 1. Closures: **Hipped**-end type.

- 1 J. Materials:
- 2 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed
- 3 applications.
- 4 2. **Recycled Content:** Postconsumer recycled content plus one-half of preconsumer recycled content not less
- 5 than **<Insert value>** percent.
- 6 K. Finish: Baked enamel or powder coat.
- 7 1. Color: **As selected by Architect from manufacturer's full range.**
- 8 2.4 LOCKS
- 9 A. Combination Padlock: **Provided by Owner.**
- 10 2.5 LOCKER BENCHES
- 11 A. Provide bench units with overall assembly height of **17-1/2 inches.**
- 12 B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
- 13 1. Size: Minimum **9-1/2 inches wide by 1-1/4 inches thick) except provide 20- to 24-inch- wide tops where**
- 14 **accessible benches are indicated.**
- 15 2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top
- 16 and sides.
- 17 C. Movable-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench
- 18 top, complete with fasteners, and as follows:
- 19 1. Stainless Steel: **1/8-inch-thick by 3-inch-wide (3-mm-thick by 76-mm-wide) channel or 1/4-inch-thick by 3-**
- 20 **inch-wide (6-mm-thick by 76-mm-wide) bar stock, shaped into trapezoidal form; with nonskid pads at**
- 21 **bottom.**
- 22 a. Finish: **Manufacturer's standard.**
- 23 D. Materials:
- 24 1. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.
- 25 2. Steel Tube: ASTM A500/A500M, cold rolled.
- 26 2.6 FABRICATION
- 27 A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make
- 28 exposed metal edges safe to touch and free of sharp edges and burrs.
- 29 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
- 30 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- 31 B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common
- 32 intermediate uprights separating compartments.
- 33 C. Equipment: Provide each locker with an identification plate and the following equipment:
- 34 1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
- 35 D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no
- 36 bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-
- 37 piece structures. Grind exposed welds smooth and flush.
- 38 E. Accessible Lockers: Fabricate as follows:
- 39 1. Locate bottom shelf no lower than **15 inches (381 mm)** above the floor.
- 40 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than **48 inches (1219 mm)**
- 41 **above the floor.**
- 42 F. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match
- 43 lockers.
- 44 G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations;
- 45 finished to match lockers.
- 46 2.7 ACCESSORIES
- 47 A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for
- 48 nuts on moving parts.
- 49 B. Anchors: Material, type, and size required for secure anchorage to each substrate.
- 50 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls[, **and**
- 51 **elsewhere as indicated,]** for corrosion resistance.
- 52 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors
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1 PART 3 - EXECUTION

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3.1 EXAMINATION

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lockers level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than **36 inches (910 mm)** o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top **and bottom of lockers**.
 - 3. Anchor back-to-back metal lockers to floor.
- B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.
- C. Equipment:
 - 1. Attach hooks with at least two fasteners.
 - 2. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
- D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach sloping-top units to metal lockers, with closures at exposed ends.
- E. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than **72 inches (1830 mm)** apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.
- F. Movable Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

- A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

**SECTION 10 90 10
TIRE CAROUSEL**

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PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.2 CONDITIONS OF THE CONTRACT

- A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.3 SUMMARY:

- A. Section includes an electric/automatic vertical tire carousel and accessory components used for high density storage and retrieval of tires.

1.4 ACTION SUBMITTALS:

- A. Product Data: Manufacturer's and installation instructions.
- B. Shop Drawings: Show any special conditions.
- C. Provide color sample(s).

1.5 INFORMATIONAL SUBMITTALS:

- A. Product Certificates
- B. Product Warranty

1.6 CLOSEOUT SUBMITTALS:

- A. Maintenance Data
- B. Manufacturer's standard one year warranty

1.7 JOB CONDITIONS:

- A. Do not deliver materials until building is enclosed and ready for installation. Protect from damage during delivery, handling, storage, and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with the specifications, provide all products from one of the following manufacturers:
 - 1. Vidir Automatic Storage Systems
 - 2. Approved equal.

2.2 MATERIALS:

- A. General: Unit shall be designed to store up to 350 tires and handle tires up to 44" in diameter. In addition, provide the following:
 - 1. Unit shall be of heavy duty steel construction, fully primed and painted and shall include side panels, carriers, shaft and cross bracing for a complete installation and for immediate use by the owner.
 - 2. Operation shall be by a fully engineered mechanism that includes motor, sprockets, chains and related components for a complete and easy to operate installation.
 - 3. Carrier shall have a load capacity of 2,000 lbs. with a live load capability of 17,000 lbs.
 - 4. Unit includes all automatic controls to fully operate the mechanism installed at ADA height.
 - 5. Travel speed shall be approximately 21 feet / minute.
 - 6. Unit shall include 208 V – 3 phase power.
 - 7. Unit includes operable mesh guards at the front of the unit.
 - 8. Actual tire capacity assumes a total of 78 tires with an 11" diameter and total capacity from up to 44" tires.
 - 9. There are a total of 6 carriers, elevated as needed, one on top of the other.
 - 10. Include moveable / adjustable ramp.
 - 11. Unit shall include a variable frequency drive (VFD).
 - 12. Provide motorized tire "kicker" to facilitate removal of tires from the unit.
- B. Provide all accessories and fasteners for a complete installation.
- C. Unit is based on Vidir HT54 unit.
- D. Provide manufacturer's standard color(s).

2.3 FABRICATION OF UNIT:

- A. Construction: Shop fabricate complete assembly and deliver to the site in the least number of part necessary. If shipped in parts, include field assembly.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Follow the manufacturer's instructions for assembly and mounting.
- B. Verify that the floor is flat and level and shim as required, as recommended by the manufacturer.

3.2 INSTALLATION:

- A. Install unit at location shown, in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.
- B. Install unit per the manufacturer's instructions.

3.3 ADJUSTING AND CLEANING:

- A. Adjust the complete unit so that the curtain operates in a smooth and reliable manner, as otherwise intended.

END OF SECTION

**SECTION 11 11 70
VEHICLE WASH EQUIPMENT**

PART 1- GENERAL

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes a complete heavy duty, drive-through vehicle/bus wash system including all fixed and operational components, which are designed, installed, tested and warranted by the contractor of this section.
- B. System includes a wrap-around, 4 column, 4 brush system, with oscillating overhead mop, and high-pressure front / wheel sprays. Included are all associated components including all pumps, sprayers, piping, water softener, valves, heater, rails, sub-components, boosters, accessories, fasteners and all related components for a complete installation. System shall also include undercarriage wash.
- C. The work shall include the piping, exposed air lines, electrical connections and routing from the main mechanical connections and electrical J-box panel. Refer to mechanical and electrical drawings for locations and conditions.
- D. System is activated by in-floor skid plates or in-floor sensors / loops which start the system.
- E. System shall be capable of cleaning front, rear, bottom, top and sides of vehicles. Any unlisted components, such as internal controls, wiring, panels, operational components, valves, washers, accessories and related items are a part of this work.
- F. The system also includes an automated dryer system and a "soft start" for the motor.
- G. Locate the majority of the equipment within the wash bay storage room located west of the wash bays, except where items are needed directly adjacent to the wash system, for visual or technical reasons.
- H. There are two wash bays at the service bay location, one equipped with a complete wash system (east) and another (west) equipped with all work that is below the floor slab so that future installation of the pumps can be performed without demolishing or removing any concrete. This includes but is not limited to the following:
 - 1. Under-carriage wash unit.
 - 2. Piping and conduits.
 - 3. Electrical work.
 - 4. All associated below-slab components for the future wash system, including the dryer.
 - 5. Install all related piping below the floor slab extending piping up through the slab, capped off as required.
- I. In addition to the above work in item H, provide an undercarriage wash in the bus storage area, as shown. In addition to the actual sprayer, pump, storage and infrastructure, provide a loop to activate the system. Included shall be a manual override to turn the loop on or off.

- J. Provide guide rails, mounted to the floor, to control movement of buses through the service bay. Note this section is to provide and install rails at all locations shown including the wash area and vacuum area.
- K. Section includes water recycling / reclamation system.
- L. Section includes a complete under-carriage wash at two locations with under-slab infrastructure at the future bay to facilitate installation of unit in the future, locations as shown on the drawings. Installation of this shall be coordinated with the general contractor, concrete contractor, and plumbing contractor.
- M. Since the exact means and methods of cleaning vehicles differs from manufacturer to manufacturer, portions of this specification omit exact equipment specifications, indicating performance and operational goals instead.
- N. The wash system shall be used to clean standard single deck buses and two component articulated buses.
- O. All major components shall be 460/480V, 3 phase. This must be verified with the electrical contractor and the set of documents provided within this project set of documents.
- P. Mount all equipment so that wash exposure to the vehicles allows for a complete surface cleaning of the vehicles. Mount equipment on pads or devices to protect the equipment.
- Q. Contractor of this section may self-perform all electrical and mechanical work or shall sub-contractor with another qualified party. All internal work within the wash bay is the responsibility of the wash bay contractor for a complete package, ready for use by the owner. This includes all wiring, conduits and connections.
- R. As noted, there will be an additional wash system provided in the future. The contractor of this section shall provide rough in for the future framework, with any locations for extensions located between the proposed wash bay and the bay adjacent to this. Note that the undercarriage wash for the future bay location shall be included as a part of this section.
- S. This section includes extra parts, as specified herein.

1.2 SUBMITTALS

- A. General Product Data: Submit the following:
 - 1. Manufacturer's product data.
 - 2. Manufacturer's installation instructions, as applicable.
 - 3. Catalog pages illustrating products to be incorporated into the project.
- B. Project specific information:
 - 1. Detailed layouts of equipment, piping, controls, rails and related items.
 - 2. Detailed plan and layout drawings of undercarriage wash.
 - 3. Details layout and description of controls.
 - 4. Detailed information on dryer system.
- C. UL and NEC certification relative to electrical components.

1.3 CLOSEOUT SUBMITTALS

- A. General: Submit listed submittals in accordance with Contract Conditions and submittals section.
- B. Operation and Maintenance Data:
 - 1. Submit operation and maintenance data for installed product as follows:
 - a. Manufacturer's instructions detailing maintenance requirements.
 - b. Parts catalog showing complete list of available parts.
 - c. Replacement parts with cuts and identifying numbers.
- C. Warranty Documentation: Submit warranty documents specified.

1.4 EXTRA PARTS

- A. Provide the following extra parts at the completion of the project:
 - 1. Brushes (a total of one half of all the brushes supplied as a part of the complete system.)
 - 2. Solenoid valves: A total of 6.

1.5 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Minimum of 5 years of experience in manufacturing systems and components similar to or exceeding requirements of this project.
 - b. Sufficient capacity to produce and deliver required materials without causing delay in work.

- c. Capable of providing field service representation during and after construction.
2. Installer: Acceptable to manufacturer.
3. Contractor shall be capable of maintaining any failures or operational issues on a timing basis. As a part of the bid, contractor shall provide 24 hour on-call service during the first year of operation.
4. Pre-installation conference: contractor shall arrange and administer a pre-installation conference which will include the Owner, Architect, related subcontractors and the key personnel of the general contractor. This shall occur prior to the placement of the concrete floor slab.
5. Training: As a part of this contract, contractor shall provide a minimum of two sessions to instruct and coach the Owner on use of the equipment.
6. All specialized electrical equipment shall be certified by UL (Underwriters Laboratories) or equivalent.

1.6 DELIVERY, STORAGE & HANDLING

- A. Delivery and Acceptance Requirements:
- B. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.
- C. Storage and Handling Requirements: Store materials protected from exposure to harmful weather conditions and at temperatures recommended by the manufacturer.

1.7 WARRANTY

- A. Warranty: Refer to Contract Conditions and Section in Division 1 for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under other Contract Documents.
 1. Warranty Term: 2 years parts, one year labor, commencing on date of substantial completion.
 2. Extended Inspection: 4 years of annual inspection as a part of the contract. Provide a report at the end of the inspection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to requirements and specifications provided herein, acceptable manufacturers are as follows:
 1. InterClean
 2. NS Wash
 3. Ross-White
- B. The specification is based on Ross-White systems.

2.2 MATERIALS / SYSTEM

- A. Description: Manufacturer shall provide all system components, whether listed within this specification or not. Proprietary components are not listed within this specification.
- B. Certain components listed herein vary from manufacturer and allowances shall be made for the manufacturer to provide components that have been used, designed and included as a part of the manufacturer's standard wash system.
- C. System components: The following components are listed as a guide although not necessarily complete:
 1. Brush columns (4), retractable arms and framework.
 2. Spray shield assembly, rear spray arch and dual rinse arch.
 3. Detergent pumps, pumping modules, chemical metering pumps and booster pumps (for continuous pressure) and related.
 4. Water softener and high efficiency, 95% condensing hot water heater.
 5. High Pressure wash assembly, framework, piping and components.
 6. Solenoid valves, shut-off valves, isolation valves, gauges, regulator and related.
 7. Nozzles/spinners, casings, sleeves, bearings, shafts, couplers, fasteners and related.
 8. Motor: HD type, "soft start" type, with a 1.15 service factor, able to accommodate an average of 40 washes per hour.
 9. High pressure water tank: High capacity polyethylene tank (or equal) with high and low float levels, using fresh municipal water. Include a 2" slow closing solenoid activated by the high float switch.

10. Blower / Dryer System: The system shall be a pair of HD blower dryers located at the end of the bay with multiple cones/blowers at each side. Blowers shall be built of stainless steel, aluminum or poly (non-corrosive material). Each blower shall include multiple adjustable blower nozzles directed towards the vehicle.
11. Undercarriage wash: Manufacturer's standard in-floor system consisting of spinners or sprayers under high pressure conditions.
12. Guide rails: Heavy duty stainless steel tubes with mounting flanges and stainless bolts to securely fasten rails to the concrete floor.
13. Electrical panel and electrical related: The Industrial quality panel shall be manufactured and evaluated in accordance with the Underwriters Laboratories, Inc. (UL) standard 508A (Industrial Control Panels). In addition, the panel shall be evaluated for high-capacity short circuit withstand and shall bear the appropriate UL marks including the short circuit withstand value mark as part of the official UL label.
14. Electrical components:
 - a. The panel shall be designed for operation on a 460/480 Volt, 3 phase, 60 Hertz system, with a short circuit capacity of 25,000 amperes RMS Symm. available at the incoming line terminals of the control panel. The panel shall be designed to meet the requirements of the National Electric Code (NEC) Articles 430 and 670, also the National Fire Protections Association (NFPA) Standard 79 (Industrial Machinery).
 - b. All push buttons, selector switches, pilot devices, system control and access functions shall be by touch screen operation, model as recommended by the manufacturer. Access to modify any operational or timing functions shall be password protected. The electric panel shall be equipped with modem to enable remote electric trouble shooting and program upgrading.
 - c. Provide all internal field wiring including conduit, cable, boxes, motors, waterproof disconnects, switches and related items for a complete installation (NEC certified).
 - d. Signal lights: HD exterior quality, in yellow colored box, with two lights, red and green, electrically inter-connected to controls to indicate if the wash bay is in use or ready for use by a new operator. Total of 7.
15. Detergent: Initially supply enough detergent to wash 75 vehicles.
16. Water Softener: Manufacturer's standard.
17. Controls: As noted above and below.
 - a. Includes weather-proof boxes, dual-height pedestals, controls, relays, delay features and related.
18. Water recycling / reclamation system:
 - a. Provide all piping, pumps, tanks, valves and infrastructure to include water reclamation of the drain water so that a minimum of 80% of the water used to wash buses is recycled for further use as clean water and the remainder can be used to soften water for use in cleaning buses.
 - b. Manufacturers vary on the means and methods. Performance of the system is key to the success of the operation.
 - c.

2.3 PERFORMANCE AND OPERATION

- A. Operation: The vehicle wash shall be actuated in cycle sequence by vehicles driven in a fixed path between tire guides at a slow speed (50-60 feet/ minute) through the washing system. All washing operations shall be automatically activated by the vehicle (driving through).
- B. The supplier is responsible to design the equipment to satisfactorily wash up to 40 conventional buses per hour (or 20 articulated buses). The vehicle wash shall be able to remove all visible, heavy dirt accumulation and most of the road film from the owner's vehicles when they are driven through the washer at 50 feet/min with using only alkaline detergents. The amount of detergent used per vehicle to remove road film shall not exceed 0.35 gallons. The evaluation of the system capability to remove road film shall be determined only after the vehicles have dried after the washing has been completed.
- C. The supplier is solely responsible for equipment performance. Should the equipment not perform, as per these specification requirements, the supplier shall modify, add and/or alter the equipment supplied at their own expense until the performance is satisfactory. The Owner shall approve all such changes. Should the performance criteria not be met after the changes, the supplier shall remove the system at no cost to the owner.

1. Visually, at the end of a wash, on a day when ice build-up is not present prior to wash, vehicles shall appear to be clean and dirt-free from a distance of 20' from the vehicle.
 2. During extreme weather conditions, after pre-cleaning and washing of a vehicle with an auxiliary hose, the appearance of the exterior shall be acceptable, as noted above.
 3. The under-carriage of vehicles shall clean all salt and debris, except in the most extreme weather conditions. As a rule of thumb, 90% of the residue shall be removed during wash operations.
 4. Since subjectivity is involved, it is important for the manufacturer to indicate levels of expectation and performance during the bidding / submittal period. This will be used as criteria for determining acceptability during actual wash operations.
- D. System operation shall be as follows:
1. Control light remains red while the system is in use.
 2. Once light turns green, the next vehicle operator passes over the loop to activate system.
 3. Upon entering wash bay, the vehicle goes through each cycle with a timer to activate each of 7 steps with signal lights operating in sequence.
 4. Pre-rinse cycle begins, automatically followed by wash and rinse cycles.
 5. At the end of the wash cycle, vehicle enters dryer area, which is automatically activated, sequenced after a delay in the wash system, which shall also be adjustable.
 6. Dryer system shall include an on/off switch to de-activate dryer during periods when the dryer is not needed.
 7. When system wash is complete, the light re-activates with a green light to alert the next driver.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to vehicle lift installation.
1. Prior to installation of the floors, walls and ceiling, consult with the General Contractor on any embed requirements, clearance requirements, tolerances and any other item that will affect the proper installation of wash bay equipment. Do not begin installation until conditions are acceptable.
 2. Prior to installation, review the wash bay shell and insure that all base components have been erected properly and conditions are acceptable for installation of the equipment. Inform Architect of unacceptable conditions immediately upon discovery.
 3. Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- A. Perform initial layout and measurements, to every extent necessary, to ensure the equipment fits, system is adequate for the conditions, ensuring that all preliminary work has been performed.
- B. Organize a pre-construction meeting, which should occur prior to installation of the floor and equipment.

3.3 INSTALLATION / SET-UP

- A. Uncrate and assemble all parts and components necessary for operation. Examine and operate all system components to ensure complete and safe operation.
- B. Assemble and adjust in accordance with manufacturer's written instructions.
- C. Accurately fit, align, securely fasten and install free from distortion or defects. Ensure that equipment is in accordance with manufacturers' supplied installation drawings and specifications. All materials and equipment shall be new, shipped and received consistent with the manufacturer's shop tolerances and finish requirements.
- D. The equipment shall be installed and all parts assembled by trained mechanics and foremen, experienced with the installation of wash bay equipment. Foreman shall be on site and available until all system components are fully operational, adjusted to the specified performance and connections to the primary electrical and mechanical system are completed.
- E. All electrical work performed under this section shall be performed by skilled and certified electricians, whether working directly for this contractor or as a subcontractor to the contractor of this section.
- F. Manufacturer shall work with the owner in performing trial washes, using the Owner's equipment. Perform the trial runs until the system performance is satisfactory to the Owner and Architect.

3.4 ADJUSTING

- A. Adjust components and systems for correct function and operation in accordance with manufacturer's written instructions, and meet the performance expectations as noted herein.
- B. Lubricate moving parts to operate smoothly and fit accurately.

3.5 CLEANING

- A. Upon completion, remove surplus materials, rubbish, tools and equipment.

3.6 CLOSEOUT ACTIVITIES

- A. Demonstration: Coordinate requirements for instruction and demonstration with the Owner.
- B. Training: Coordinate training with the Owner in order to meet their schedule. Advise in advance the time necessary to complete this task.

3.7 PROTECTION

- A. Protect installed product from damage.
- B. Repair damage to adjacent materials caused by vehicle lift installation.

END OF SECTION 11 11 70

**SECTION 11 24 19
AUTOMATED VACUUM SYSTEM**

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes industrial, heavy-duty automated bus vacuum system including operable structure/shroud assembly, controls, air lines, piping, interior electrical work and connections and all related elements for a complete and operational system.
- B. The owner will be cleaning both traditional single-deck buses and two-component articulated buses.
- C. System shall be designed to effectively remove all dust, dirt and debris from the interior of a bus and shall do so using de-odorized air.
- D. This section is specifically written without certain details to allow manufacturers to use their proprietary systems provided that all performance details noted herein are achieved.
- E. The work shall also include all visible piping, air lines, electrical connections, and routing from the rough-in locations provided and from the main disconnect located within the was/vacuum bay. Refer to mechanical and electrical specifications and drawings for locations, capacities and details.
- F. Installation of this shall be coordinated with the general contractor, concrete contractor, and plumbing contractor prior to any of the floor and sub-floor work.
- G. All major components shall be 460/480 V, 3 phase. This must be verified with the electrical contractor and set of documents provided within this project manual.
- H. Contractor of this section may self-perform all electrical and mechanical work or sub-contractor with another qualified party. All internal work to the wash bay is the responsibility of the wash bay contractor for a complete package, ready for use by the owner.
- I. If the contractor of this section is not versed or certified in electrical or mechanical work, they shall hire a subcontractor or work with other contractors on-site, provided that all associated costs are a part of this section. All work, including mechanical and electrical connections and distribution is a part of this section.
- J. Considerations shall be made for an additional system to be mounted alongside the unit which is a part of this phase of work. Air lines and electrical shall be included in the mechanical an electrical work for the future installation.
- K. A pre-install meeting is required prior to the start of any work.

1.2 SUBMITTALS

- A. General Product Data: Submit the following:
 - 1. Manufacturer's product data.
 - 2. Manufacturer's installation instructions, as applicable.
 - 3. Catalog pages illustrating products to be incorporated into project.
- B. Project specific information:
 - 1. Detailed layouts of equipment, piping, controls, and related items.

2. Detailed plan and layout drawings of undercarriage wash.
 3. Details layout and description of controls.
- C. UL and NEC certification relative to electrical components.

1.3 CLOSEOUT SUBMITTALS

- A. General: Submit listed submittals in accordance with Contract Conditions and submittals section.
- B. Operation and Maintenance Data:
1. Submit operation and maintenance data for installed product as follows:
 - a. Manufacturer's instructions detailing maintenance requirements.
 - b. Parts catalog showing complete list of available parts.
 - c. Replacement parts with cuts and identifying numbers.
- C. Warranty Documentation: Submit warranty documents specified.

1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturer:
 - a. Minimum of **5** years of experience in manufacturing systems and components similar to or exceeding requirements of project.
 - b. Sufficient capacity to produce and deliver required materials without causing delay in work.
 - c. Capable of providing field service representation during and after construction.
 2. Installer: Acceptable to manufacturer.
 3. Capable of maintaining any failures or operational issues in a timing basis. As a part of the bid, contractor shall provide 24 hour on-call service during the first year of operation.
 4. Pre-installation conference: contractor shall arrange and administer a pre-installation conference which will include the Owner, Architect, related subcontractors the key personnel of the general contractor.
 5. Training: As a part of this contact, contractor shall provide a minimum of two sessions to instruct and coach the Owner on use of the equipment.
 6. All specialized electrical equipment shall be certified by UL (Underwriters Laboratories) or equivalent.

1.5 DELIVERY, STORAGE & HANDLING

- A. Delivery and Acceptance Requirements:
- B. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.
- C. Storage and Handling Requirements: Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.

1.6 WARRANTY

- A. Warranty: Refer to Contract Conditions and Section in Division 1 for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under other Contract Documents.
1. Warranty Term: 2 years parts, one-year labor, commencing on date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Manufacturers shall have a proven track record of providing vacuum systems equivalent to the system specified herein. Manufacturers that are acceptable are as follows, subject to the provisions provided herein:
1. Eurovac
 2. Ross-White
 3. Approved equal.

2.2 MATERIALS / SYSTEM

- A. Description: Manufacturer shall provide all system components, whether listed within this specification or not. Proprietary components are not listed within this specification.
- B. System components: The following components are listed as a guide although not necessarily complete:

1. Retractable bellows assembly including seals and mechanical/operational components. The bellows is located to readily access the middle door or the articulated bus.
2. Primary motor/fan with a minimum 20 HP capacity and secondary fan at dust collector (5 HP)
3. Trash housing enclosure with access doors and air filter.
4. Separate trash container: Provided below the opening within the enclosure, provided by the owner.
5. Dust collector / filter.
6. Power unit and controls.
7. Air-sweeping guns.
8. Coiling type hoses, yellow and 50' in length, with hooks located within the unit.
9. Supports, air lines, piping and all other related components.
10. Electrical components:
 - a. The panel shall be designed for operation on a 460/480 Volt, 3 phase, 60 Hertz system, with a short circuit capacity of 25,000 amperes RMS Symm. available at the incoming line terminals of the control panel. The panel shall be designed to meet the requirements of the National Electric Code (NEC) Articles 430 and 670, also the National Fire Protection Association (NFPA) Standard 79 (Industrial Machinery).
 - b. Provide all internal field wiring including conduit, cable, boxes, motors, waterproof disconnects, switches and related items for a complete installation (NEC certified).

2.3 PERFORMANCE AND OPERATION

- A. Operation: System shall be designed and manufacturer to remove all dirt, dust, debris and articles from the bus, including newspapers, cups and lightweight items via a high velocity fan, separating solids from the air and depositing them into the trash unit.
- B. System shall be installed based on manufacturer's standards and shall be tested to the satisfaction of the owner before the system is turned over to the owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to vehicle lift installation.
 1. Prior to installation of the floors consult with the General Contractor on any rough-in, embed requirements, clearance requirements, tolerances and any other item that will affect the proper installation of the vacuum system. Do not begin installation until conditions are acceptable.
 2. Prior to installation, review the equipment and ensure that all base components have been erected properly and conditions are acceptable for installation of the equipment. Inform Architect of unacceptable conditions immediately upon discovery.
 3. Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- A. Perform initial layout and measurements, to every extent necessary, to ensure the equipment fits, system is adequate for the conditions, ensuring that all preliminary work has been performed.
- B. Organize a pre-construction meeting, which should occur prior to installation of the floor and equipment.

3.3 INSTALLATION / SET-UP

- A. Uncrate and assemble all parts and components necessary for operation. Examine and operate all system components to ensure complete and safe operation.
- B. Assemble and adjust in accordance with manufacturer's written instructions.
- C. Accurately fit, align, securely fasten and install free from distortion or defects. Ensure that equipment is in accordance with manufacturers' supplied installation drawings and specifications. All materials and equipment shall be new, shipped and received consistent with the manufacturer's shop tolerances and finish requirements.
- D. The equipment shall be installed and all parts assembled by trained mechanics and foremen, experienced with the installation of wash bay equipment. Foreman shall be on site and available until all system components are fully operational, adjusted to the specified performance and connections to the primary electrical and mechanical system are completed.

- E. All electrical work performed under this section shall be performed by skilled and certified electricians, whether working directly for this contractor or as a subcontractor to the contractor of this section.

3.4 ADJUSTING

- A. Adjust components and systems for correct function and operation in accordance with manufacturer's written instructions and meet the performance expectations as noted herein.
- B. Lubricate moving parts to operate smoothly and fit accurately.

3.5 CLEANING

- A. Upon completion, remove surplus materials, rubbish, tools and equipment.

3.6 CLOSEOUT ACTIVITIES

- A. Demonstration: Coordinate requirements for instruction and demonstration with the Owner.
- B. Training: Coordinate training with the Owner in order to meet their schedule. Advise in advance the time necessary to complete this task.

3.7 PROTECTION

- A. Protect installed product from damage.
- B. Repair damage to adjacent materials caused by installation.

END OF SECTION

**SECTION 11 60 05
VEHICLE FUELING SYSTEM**

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PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.2 CONDITIONS OF THE CONTRACT

- A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.3 SUMMARY

- A. Section includes fully engineered, fully integrated, above-grade / above-ground type vehicle fueling system and associated work. The scope of work includes all components, connections, equipment, and installation as required for a complete installation. The work includes all approvals, government certifications, permits, and related items as required to complete the project.
- B. The work includes fueling systems with integrated controls for use at the site and compatible with the Owner's existing Fuel Master Ames system, located at a different site.
 - 1. Both the fuel bay location and the exterior location of the fueling island shall include specified pedestal and access control system.
- C. All fuel tanks shall be above-grade type. All piping shall be extended under-round from tank to dispensers.
- D. Section includes the following at the easterly fleet storage building:
 - 1. Tank shall be located at the exterior of the building, with piping extending down below grade and extending up into the fueling bay to the dispenser.
 - 2. Provide a complete fueling system with an above-grade tank and indoor fueling dispenser (east bay.)
 - 3. Also provide complete below-slab / below-grade components for a future second dispenser (west bay.)
 - 4. Provide leak detection unit / controls at the equipment room east of the interior fueling bay for the fueling bay location: this needs to be verified with the Owner prior to the work.
- E. Section also includes one above-grade split tank located at the easterly portion of the fleet storage building. One half of the tank shall be for diesel and the other for standard gasoline.
 - 1. Tank shall be located at the exterior.
 - 2. Provide fueling island (as shown on the drawings) including 6" high slab, curb with stainless steel edging.
 - 3. Provide leak detection unit / controls within the building near the exit door: verify exact location.
- F. The work of this section includes the following in summary form:
 - 1. Interior fueling bay: Digital, single product, 1-hose, high flow dispenser with nozzles, hoses, swivels and break-aways
 - 2. Provide dual component, twin hoses with standard flow dispensers, nozzles, hoses, swivels and break-aways at

- the Buildings and Grounds location, SW corner of the maintenance building.
 3. Submersible pumps with control boxes and leak detectors.
 4. One double-wall coated steel tank, with a total 10,000-gallon capacity for diesel fuel at fueling bay.
 5. One double-wall coated split steel tank, with 500 / 500-gallon capacity for regular fuel and diesel fuel for the Buildings and Grounds department.
 6. Low-level fuel alarms at tanks.
 7. Components including fittings and connections, specifically designed for biofuels and E85 fuels, all locations, although this type of fuel will not be initially used by the owner.
 8. All components used within the service bay and at the island are to be explosion-proof.
 9. Collars, risers, and covers.
 10. Sumps and covers.
 11. Transitional sump at fueling bay.
 12. Rigid piping, valves, and connections (flexible piping is not to be used).
 13. Electrical line leak detection.
 14. Venting as required for each tank.
 15. Computer software for monitoring system.
 16. Controls, pedestal, software and operational components.
 17. Wireless system for all low-voltage items.
 18. Trenching and backfilling.
 19. Weather-proof island terminal, controls, keys for operation.
 20. Probes, sensors, caps, modules as required.
 21. Conduits for electrical wiring and conduit for low voltage wiring (see below).
 22. Programming, startup, and coordination with Owner.
 23. Temporary connections and supports.
 24. Installation of interior / exterior emergency shut-offs, located as shown on the drawings.
 25. Coordination and approvals with Governmental agencies.
 26. Vents and piping.
 27. All associated earthwork.
 28. Electrical connections and coordination with electrical contractor. All related electrical work outside of the building by fuel island contractor.
 29. Permits and certificates.
 30. All related work for a complete installation.
- G. The owner is currently using Electronic Monitoring Control (EMC) at their other site. The contractor of this section shall coordinate with the owner so that this fueling system is synchronized with their EMC.
- H. Conduits: Provide a sufficient number of conduits (1" or greater as recommended by the manufacturer) and shall include one additional empty conduit for use as the case may be – at both locations. In addition, the work of this section includes running the line from the tanks to the building, continuing through the building and to the mechanic's office.
- I. Note: The owner is currently using a Fuel Master system for controlling and operating the system. All new work shall be integrated with this system.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's and installation instructions.
- B. Shop drawings: Plans and details indicating all features and components of this system, below-grade conditions, equipment, and related items.
- C. Maintenance Manuals.
- D. Certifications and permits: Provide copies of all certifications, permits and approvals.

1.5 CLOSE-OUT SUBMITTALS

- A. Warranty: Provide warranty, signed by the manufacturer and installer to cover all defects, parts, operational items, and related items for continued use by the Owner.

1.6 QUALITY ASSURANCE

- A. Installer: Installer shall be certified by the manufacturer for installation of fueling systems lifts and shall have a minimum of 5 years of experience in doing so.
- B. Codes and Standards. The supplier / contractor shall supply / install systems that comply with the following:
 1. ASTM Spec D 4021-92.
 2. ULC (pipe and related accessories).

3. NFPA Standards 30.
4. MPCA rule 7150
5. API Standard 1615
6. UFC, latest approved edition
7. PEI, RP 100-2000
8. International Building Code
9. All state and local codes
10. State Mechanical Code
11. State Electrical Code

1.7 WARRANTY

- A. Provide a one-year warranty covering all parts and labor. This shall be provided on an emergency basis with repairs performed within a 48-hour period.

1.8 JOB CONDITIONS

- A. Coordinate work with the general contractor and all related trades. Portions of this section are to be done before, during and after other work is performed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturers: Listed below are manufacturers that have been pre-approved for installation. Other manufacturers will be considered prior to bid date. Provide Architect with complete product information for review within 5 days of bid due date for consideration.
 1. Refer to the specific system components below for acceptable manufacturers.

2.2 MATERIALS AND SYSTEMS:

- A. Provide all components necessary for a complete installation. Key components include those itemized below.
- B. Dispensers and Accessories: Heavy duty, enameled steel, digital, UL listed unit with cabinet, register with automatic hoses, swivels, and break away valves. Units shall have vertical rail features. Provide twin 20' (minimum) length hoses at each dispenser location.
 1. Provide fueling capacity at 22 GPM at bus fleet location at the Southeast portion of the building.
 2. At the service bay provide high-flow Emco Wheaton lock-in dispensers to that there is a firm and tight connection to the vehicles. Contact Owner/Architect for more detail if needed.
 3. Provide 20 GPM capacity at the two tanks at the exterior fueling island for Buildings and grounds.
 4. Provide counterweight hose retractors with pulley assembly, with hose lengths of 20'.
 5. Hoses shall be 3/4" (gas) / 1" (diesel) in size.
 6. Provide dispenser unit with internal spin-on filter, brushed stainless doors and panels, hose clamps, explosion-proof boxes and internal hose retractors. Verify size and length of hose with the Architect during shop drawing phase.
 7. Each unit shall be set up for 1 product, with 1 hose at dispenser.
- C. Submersible Pump: Provide 1-1/2 horsepower, as recommended by the manufacturer, submerged unit sized per the tank specifications and tank manufacturer's recommendations. Include control box and lock out. Provide Franklin, Petro STP or Red Jacket, with CBS type control box.
- D. Dispenser Sump: Franklin Fueling Systems or OPW to fit dispenser with stabilizer bars and entry boots.
- E. Sumps: Provide rectangular and round polyethylene transition sumps dispenser sumps.
- F. Tanks and components: As follows:
 1. Two double-wall tanks as follows:
 - a. Equal to Fire Guard 2085 (Lannon and Ugemco pre-approved)
 - b. 2-hour rated fiberglass tanks, NFPA 30 A.
 - c. UL labeled and listed 2085, STI Fireguard UL or equal.
 - d. Integrated ladder for access to the top of tank.
 - e. Include all flanges, stacks, ports, gauges and accessories for a complete installation.
 - f. Provide tanks as manufactured by Fireguard or approved equal.
 2. Provide 22" wide clear "manway" with associated attachment and 3' high collar risers and friction-fit cover as recommended by the tank manufacturer. Provide Xerxes Corporation, Containment Solutions or approved equal.

3. Remote Emergency Shut-off: Manually operable power disconnects of weatherproof construction with easy-to-identify and use button or plate that is ADA accessible, with materials and installation methods recommended by the NECA. Refer to the drawings for location and verify location in field with the Architect and Fire Marshal.
 - a. The shut-off at the main fueling bay shall be at the interior, location as shown on the drawings.
 - b. The shut-off at the Buildings and Grounds location shall be at the exterior.
 4. Above Grade, Below Grade and Transitional Piping: 2" Double wall APT flexible pipes to meet Federal and state requirements UL listed: Franklin, Smith or Ameron.
 5. Auto-leak Gauge: Provide Franklin EVO 600 as otherwise specified.
 6. Sump Sensors: As recommended by the manufacturer.
 7. Automatic Leak Protection: Provide web-based digital control unit with built-in microprocessor and displays, using continuous leak detection for three tanks, both float type and dry type, along with associated system components. Provide self-diagnostic and self-identifying sensors including all wiring and connections to the control unit. Provide floats, probes, and all related items.
 - a. System shall be Franklin Fueling Systems EVO 600 with NEMA 4 enclosure.
 - b. Web-based unit shall be capable of up to 32 probes.
 - c. Web access shall be provided by the Owner to the site location.
 8. Fuel Control System: Provide web-based fuel system digital controller (for hose capacity specified herein, used simultaneously), terminal, and system software to monitor and control fueling system using a keypad for access control. Terminal shall have backlit signal, keypad, lockable control access door and enclosure unit, mounted to the fuel island slab. Control shall be a remote, digital menu-driven program. Software shall include basic database information along with integrated, centralized card/prox database, data reporting, odometer check, NS RWLRWS items for a complete installation.
 - a. Provide Fuel Master Ames (Syntex) system for all locations.
 - b. Provide FSC3000 controls (or equal brain) with automatic cell modem for connectivity.
 - c. Controller unit shall be mounted within the terminal.
 - d. Unit shall be upgradable for possible future connection to the "cloud."
 9. Provide integrated control unit / pedestal at each location, mounted to the floor/island, as applicable. Unit shall be Fuel Master FMU 3000.
- M. Wiring and Conductors: Rated and labeled buried wiring installed per the equipment manufacturer's instructions.
- N. Wireless Unit: Provide wireless system for all low-voltage equipment and accessories. Coordinate with Owner on signal requirements and installation.
- O. Concrete Gas Island at Buildings and Grounds location, provide slab-on-grade and curbs: Provide high strength, reinforced concrete island, minimum 3500 psi. Stainless steel forms are to be provided at the slab edge. Slab shall be a minimum of 6" tall.
- P. Steel Bollards: Upside down, U-shaped. Refer to drawings for general configuration and size of the galvanized carbon steel bollards at either end of the fueling island. Paint in color as selected by the Architect.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Field Conditions: Verify conditions in the field prior to order, delivery and installation.
- B. Take field measurements prior to shop drawing preparation, as necessary.
- C. At the point of the project at which the existing lift is to be removed (as determined by the general contractor) assist in the removal and disposition of the existing lift.
- D. Coordinate work with the General Contractor and all related trades. Provide others with baseline information on depth of under-ground materials, electrical requirements, capacities, and all other related information to ensure that the preparatory work is performed properly.

3.2 INSTALLATION:

- A. Install the fueling system and components in accordance with manufacturer's instructions for fit, clearance, plumb, level, rigidity, safety and trouble-free operation.
- B. Perform excavation and backfill with requirements noted elsewhere in earthwork and concrete sections included within this set of documents. All fill shall be adequately placed and compacted, using pea rock above the tank locations. Perform compaction tests as required to ensure that the fill material is secure and the island / equipment will not shift or move once installed.
- C. Test and re-test all piping, seals and connections during and after installation to ensure that there is trouble-free operation and that the system meets all codes and requirements.

- D. Install concrete fueling island in accordance with Section on concrete division 3. Concrete at the island and slab shall have a minimum of 3,500 psi (28 days).
 - 1. The concrete slab and fuel island concrete shall be a minimum of 6" thickness with #5 epoxy coated bars at 12" on center, each way.
- E. Set in-ground materials, rings and manholes so that the top-of-manhole is aligned with the concrete, with no rises or means of accidentally hitting a cover or retainer during plowing operations.

3.3 ADJUSTING, CLEANING AND POST-INSTALLATION:

- A. Adjust any components as necessary to comply with the manufacturer's requirements.
- B. Lubricate, grease and oil all operational components, or wiring and components within the dispensers which could be subject to salt spray.
- C. Touch-up marred finishes but replace units which cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by the manufacturer.
- D. After all work noted above is complete, instruct the Owner on use of the entire system.

END OF SECTION

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**SECTION 11 90 05
OIL FILTER CRUSHER**

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PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.2 CONDITIONS OF THE CONTRACT

- A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.3 SUMMARY:

- A. Section includes an electric/hydraulic oil filter crusher and platform.

1.4 ACTION SUBMITTALS:

- A. Product Data: Manufacturer's and installation instructions.
- B. Shop Drawings: Show any special conditions.

1.5 INFORMATIONAL SUBMITTALS:

- A. Product Certificates
- B. Product Warranty

1.6 CLOSEOUT SUBMITTALS:

- A. Maintenance Data

1.7 JOB CONDITIONS:

- A. Do not deliver materials until building is enclosed and ready for installation. Protect from damage during delivery, handling, storage, and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with the specifications, provide all products from one of the following manufacturers:
 - 1. Industrial Diesel Products, Inc.
 - 2. Approved equal.

2.2 MATERIALS:

- A. General: Unit shall be heavy duty type designed and made for crushing oil filters up to 7" wide and 16" tall. Unit shall quietly and uniformly crush and compact oil filters. Unit shall be made from heavy duty steel members fully primed and painted.

1. Included is an integral steel frame / base which elevated above a 55 gallon tank. (Tanks not included.)
 2. Unit includes a latched and hinged access door at the front of the crusher.
 3. Unit power shall be 110 V.
 4. Provide the ability to crush several small automobile sized filters or one over-sized large filter up to 7" in width and 16" in length.
 5. Provide threaded drain at the base of the crusher so facilitate leak-proof connection to the oil drum.
 6. Crushing force shall be a minimum of 30,000 lbs.
 7. Approximate floorplate size is 24" x 33".
 8. Include automatic push button control.
- B. Provide all accessories and fasteners for a complete installation.

2.3 FABRICATION OF UNIT:

- A. Construction: Shop fabricate complete assembly and deliver to the site in the least number of part necessary. If shipped in parts, include field assembly.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Follow the manufacturer's instructions for assembly and mounting.
- B. Verify that the floor is flat and level and shim as required, as recommended by the manufacturer.

3.2 INSTALLATION:

- A. Install unit at locations shown, in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.
- B. Install unit per the manufacturer's instructions.

3.3 ADJUSTING AND CLEANING:

- A. Adjust the complete unit so that the curtain operates in a smooth and reliable manner, as otherwise intended.

END OF SECTION

SECTION 12 24 13
ROLLER WINDOW SHADES

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20 PART 1 – GENERAL
21
22 1.1 SUMMARY
23 A. Section includes:
24 1. Manually operated, single-roller shades.
25 B. Related Requirements:
26 1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and
27 accessories.
28 2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking
29 shades with a sealant.
30 1.2 SUBMITTALS
31 A. Product Data: For each type of product.
32 1. Include construction details, material descriptions, dimensions of individual components and profiles,
33 features, finishes, and operating instructions for roller shades.
34 B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their
35 orientation to rollers, and their seam and batten locations.
36 C. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.
37 D. Samples for Initial Selection: For each type and color of shadeband material.
38 1. Include Samples of accessories involving color selection.
39 E. Product Certificates: For each type of shadeband material.
40 F. Operation and Maintenance Data: For roller shades to include in maintenance manuals.
41 1.3 DELIVERY, STORAGE, AND HANDLING
42 A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation
43 using same designations indicated on Drawings.
44 1.4 FIELD CONDITIONS
45 A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including
46 painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels
47 indicated for Project when occupied for its intended use.
48 B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other
49 construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow
50 clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of
51 installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid
52 delaying the Work.
53
54 PART 2 - PRODUCTS
55
56
57 2.1 SOURCE LIMITATIONS
58 A. Obtain roller shades from single source from single manufacturer.

- 1 2.2 MANUALLY OPERATED, SINGLE-ROLLER SHADES
- 2 A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement
- 3 when bead chain is released; permanently adjusted and lubricated.
- 4 1. Bead Chains: **Manufacturer's standard.**
- 5 a. Loop Length: **Full length of roller shade.**
- 6 b. Limit Stops: Provide upper and lower ball stops.
- 7 c. Chain-Retainer Type: **Chain tensioner, sill mounted.**
- 8 B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to
- 9 accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide
- 10 with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of
- 11 shadebands for service.
- 12 1. Roller Drive-End Location: **Right side of interior face of shade.**
- 13 2. Direction of Shadeband Roll: **Regular, from back (exterior face) of roller.**
- 14 3. Shadeband-to-Roller Attachment: **Manufacturer's standard method.**
- 15 C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating
- 16 mechanism, installation accessories, and mounting location and conditions indicated.
- 17 D. Shadebands:
- 18 1. Shadeband Material: **Light-filtering fabric.**
- 19 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
- 20 a. Type: **Enclosed in sealed pocket of shadeband material.**
- 21 b. Color and Finish: **As selected by Architect from manufacturer's full range.**
- 22 E. Installation Accessories:
- 23 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and
- 24 attaches to roller endcaps without exposed fasteners.
- 25 a. Shape: **L-shaped.**
- 26 b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when
- 27 shade is fully open, but not less than **3 inches.**
- 28 2.3 SHADEBAND MATERIALS
- 29 A. Shadeband Material Flame-Resistance Rating: Comply with **NFPA 701**. Testing by a qualified testing agency. Identify
- 30 products with appropriate markings of applicable testing agency.
- 31 B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
- 32 1. Source: **Roller shade manufacturer.**
- 33 2. Fabric: ThermoVeil Basket Weave: 1300 series. 5 percent open, 2 by 2 dense basket-weave pattern.
- 34 3. Color: **As selected by Architect from manufacturer's full range.**
- 35 2.4 ROLLER SHADE FABRICATION
- 36 A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible,
- 37 chain-loop devices; lead content of components; and warning labels.
- 38 B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at **74 deg F (23 deg C)**:
- 39 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is
- 40 installed less **1/4 inch (6 mm)** per side or **1/2-inch (13-mm)** total, plus or minus **1/8 inch (3.1 mm)**. Length
- 41 equal to head-to-sill or -floor dimension of opening in which shade is installed less **1/4 inch (6 mm)**, plus or
- 42 minus **1/8 inch (3.1 mm)**.
- 43 C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible.
- 44
- 45 PART 3 - EXECUTION
- 46
- 47
- 48 3.1 EXAMINATION
- 49 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
- 50 tolerances, operational clearances, and other conditions affecting performance of the Work.
- 51 B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 52 3.2 ROLLER SHADE INSTALLATION
- 53 A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
- 54 B. Roller Shade Locations: **At exterior windows.**
- 55 3.3 ADJUSTING
- 56 A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction
- 57 throughout entire operational range.

- 1 3.4 CLEANING AND PROTECTION
- 2 A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- 3 B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure
- 4 that roller shades are without damage or deterioration at time of Substantial Completion.
- 5 C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of
- 6 Substantial Completion.
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END OF SECTION

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**SECTION 12 36 61
SOLID SURFACE FABRICATIONS**

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9 1.5 COORDINATION 1
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11 2.1 SOLID SURFACE MATERIALS 2
12 2.2 FABRICATION 2
13 2.3 INSTALLATION MATERIALS 2
14 PART 3 - EXECUTION 3
15 3.1 EXAMINATION 3
16 3.2 INSTALLATION 3
17
18 PART 1 – GENERAL
19
20 1.1 SUMMARY
21 A. Section includes:
22 1. Solid surface materials.
23 2. Solid surface material sinks.
24 3. Recycled plastic lumber materials.
25 B. Related Requirements:
26 1. Section 224100 "Residential Plumbing Fixtures" for **non-integral sinks and plumbing fittings**.
27 1.2 SUBMITTALS
28 A. Product Data: For materials **and sinks**.
29 B. Sustainable Design Submittals:
30 1. [Chain-of-Custody Certificates](#): For certified wood products. Include statement of costs.
31 2. [Product Data](#): For adhesives, indicating VOC content.
32 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting
33 materials.
34 4. [Laboratory Test Reports](#): For composite wood products, indicating compliance with requirements for low-
35 emitting materials.
36 C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and
37 cutouts for plumbing fixtures.
38 1. Show locations and details of joints.
39 2. Show direction of directional pattern, if any.
40 D. Samples for Initial Selection: For each type of material exposed to view.
41 E. Qualification Data: For fabricator.
42 F. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data
43 for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources
44 for products.
45 1.3 QUALITY ASSURANCE
46 A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that
47 required for this Project, and whose products have a record of successful in-service performance.
48 B. Installer Qualifications: Fabricator of countertops.
49 1.4 FIELD CONDITIONS
50 A. Field Measurements: Verify dimensions by field measurements **after base materials are installed but** before
51 countertop fabrication is complete.
52 1.5 COORDINATION
53 A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1 PART 2 - PRODUCTS

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3

4 2.1 SOLID SURFACE MATERIALS

5 A. Solid Surface Material: Cast, nonporous, homogeneous material (not coated, laminated or of composite
6 construction) maintaining the same composition throughout the part with a composition of acrylic polymer,
7 aluminum trihydrate and pigment complying with ISFA 2-01.

8 1. [Manufacturers](#): Subject to compliance with requirements, provide products including but not limited to one
9 of the following:

- 10 a. [Avonite Surfaces; a Brand of Aristech Surfaces LLC.](#)
- 11 b. [DuPont; DuPont de Nemours, Inc.](#)
- 12 c. [Formica Corporation.](#)
- 13 d. [Wilsonart LLC.](#)

14 2. Type: Provide Standard type unless Special Purpose type is indicated.

15 3. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.

16 4. Colors and Patterns: **As selected by Architect from manufacturer's full range.**

17 B. [Composite Wood Products](#): Verify products are made using ultra-low-emitting formaldehyde resins, as defined in
18 the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from
19 Composite Wood Products," or are made with no added formaldehyde.

20 C. Particleboard: ANSI A208.1, **Grade M-2-Exterior Glue.**

21 2.2 FABRICATION

22 A. Fabricate according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's
23 "Architectural Woodwork Standards."

24 1. Grade: **Custom.**

25 B. Configuration:

26 1. Front: **Straight, slightly eased at top.**

27 2. Backsplash: **Straight, slightly eased at corner.**

28 3. End Splash: **Matching backsplash.**

29 C. Countertops:

30 1. **1/2-inch-** thick, solid surface material **with front edge built up with same material.**

31 D. Backsplashes: **1/2-inch- (12.7-mm-)** thick, solid surface material.

32 E. Shower surrounds:

33 1. **1/4-inch-** thick, solid surface material .

34 F. Shower shelf:

35 1. Edges: Straight, slightly eased.

36 2. Surrounds: 1/2-inch- thick, solid surface material.

37 3. Shelf: 1/2-inch- thick, solid surface material.

38 4. Fabrication: Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers,
39 fabrication, and finishing. Provide 4 drainage grooves radiating from corner and starting 1 1/2" from the
40 corner.

41 G. Fabricate tops with shop-applied edges **and backsplashes** unless otherwise indicated. Comply with solid surface
42 material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

43 H. Joints:

44 1. Fabricate without joints.

45 I. Cutouts and Holes:

46 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures **in shop** using template or pattern furnished by
47 fixture manufacturer. Form cutouts to smooth, even curves.

48 a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of
49 countertop and projecting **3/16 inch (5 mm)** into fixture opening.

50 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-
51 mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of
52 largest radius practical.

53 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

54 2.3 INSTALLATION MATERIALS

55 A. Adhesive: Product recommended by solid surface material manufacturer.

56 1. [Verify adhesives have a VOC](#) content of **70 g/L** or less.

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2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."
- C. Solid Plastic Support Brackets:
1. 3-inch wide steel countertop bracket.
 2. Mounting: Surface mounted installation.
 3. Provide 0.18" material thickness.
 4. Capacity: 500 pounds.
 5. Finish: Flat black.
- D. Solid Plastic:
1. 5/4" x 8" molded grade boards.
 2. Color: Selected from supplier's full catalogue.
- E. Countertop Support Brackets:
1. 1 1/4-inch wide steel countertop bracket.
 2. Mounting: Surface mounted installation.
 3. Provide: KV 208 series heavy duty bracket.
 4. Finish: White.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of **1/8 inch in 8 feet (3 mm in 2.4 m)**, **1/4 inch (6 mm)** maximum. Do not exceed **1/64-inch (0.4-mm)** difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."
- I. Shower walls:
 1. Solid polymer material adhesively applied to approved substrate using thin-set neoprene-based panel adhesive.

END OF SECTION

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SECTION 12 46 00
MAGNETIC GLASS DRY-ERASE BOARDS

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16			
17	PART 1 – GENERAL		
18			
19	1.1 SUMMARY		
20	A. Section includes:		
21	1. fixed, magnetic, glass dry-erase boards and their mounting systems.		
22	1.2 SUBMITTALS		
23	A. Product Data: For each type of product.		
24	1. Submit minimum 6-inch by 6-inch sample in specified finish, with one sample of each piece of mounting		
25	hardware.		
26	2. Manufacturer’s product data, including installation data.		
27	3. Include mounting details, material descriptions, dimensions of individual components and profiles, and		
28	finishes including all accessories.		
29	4. Submit manufacturer’s cleaning instructions.		
30	B. Shop Drawings: Show full-size details, edge details, attachments, etc. Show largescale elevations, plan views		
31	showing room locations and mounting dimensions, cross sections, and tags for each unit to be installed.		
32	C. Manufacturer’s Certification: Submit manufacturer’s certification that materials comply with specified requirements		
33	and are suitable for intended application.		
34	D. Warranty Documentation: Submit manufacturer’s written warranty (minimum 20 year) covering material and		
35	workmanship, normal wear excepted.		
36	1.3 QUALITY ASSURANCE		
37	A. Manufacturer Qualifications: Manufacturer shall have produced magnetic glass dryerase boards similar to those		
38	required for this Project for no less than 10 years.		
39	1.4 PROJECT CONDITIONS		
40	A. Field Measurements: Verify field measurements and indicate measurements on Shop Drawings to ensure required		
41	fit.		
42	1.5 DELIVERY, STORAGE AND HANDLING		
43	A. Deliver only after submittal data is approved and field conditions have been verified.		
44	B. Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly		
45	identifying product name and manufacturer.		
46	C. Keep materials in manufacturer’s original, unopened containers and packaging until installation.		
47	D. Store and handle materials in accordance with manufacturer’s instructions.		
48	E. Store materials in ventilated place, protected from the weather and with a relative humidity of 60% or less at not		
49	less than 60 degrees to 85 degrees Fahrenheit (F).		
50	F. Protect materials during storage, handling, and installation to prevent damage.		
51			
52	PART 2 - PRODUCTS		
53			
54			
55	2.1 MANUFACTURERS		
56	A. Manufacturers and Products: Subject to compliance with requirements, available manufacturers and products that		
57	may be incorporated into the Work include, but are not limited to, the following:		

- 1 1. Basis of Design: Glass Whiteboard.com – Professional Series, 2453 American Lane, Elk Grove Village, Illinois,
2 60007, 1-877-793-1011
- 3 2. Other manufacturers: Similar products by other manufacturers:
4 a. Acco Brands – Quartet Brilliance, Four Corporate Drive, Lake Zurich, Illinois 60047, 1-847-541-9500
5 b. Clarus – Float+Depth, 7537 Jack Newell Blvd N, Fort Worth Texas 76118, 888-813-7414
- 6 B. Dry-erase boards
7 1. Steel backed tempered glass.
8 a. Minimum 0.020-inch thick steel plate.
9 2. Adhesive: Acrylic adhesive sheet.
10 3. Coating: White enamel baked-on coating.
11 4. Glass: 6mm thick, tempered, low-iron glass with high-flat, polished edges and square corners.
12 5. Size: Refer to Drawings.
- 13 C. Accessories: Meet or exceed standards of ANSI Z359.13 and 29 CFR Part 1910.140.
14 1. Edge grips: Four, round brushed stainless steel.
15 2. Toggle bolts: 3/16"
16 3. Accessory tray: Aluminum, minimum 48" long.

17
18 **PART 3 - EXECUTION**
19
20

21 **3.1 INSTALLATION**

- 22 A. Contractor to provide blocking at all install locations.
- 23 B. Examine walls to receive dry-erase boards.
- 24 C. Notify Architect of conditions that would adversely affect installation or subsequent use.
- 25 D. Do not begin installation until unacceptable conditions are corrected.
- 26 E. Install according to the approved shop drawings and manufacturer's instructions. Install anchorage and fasteners in
27 accordance with manufacturer's recommendations to obtain the allowable working loads published in the product
28 literature and in accordance with this Section.
- 29 F. Install accessories in accordance with manufacturer's instructions.
- 30 G. Install all accessories in accordance with applicable barrier-free accessibility regulations.

31 **3.2 CLEANING**

- 32 A. Clean dry-erase board promptly after installation in accordance with manufacturer's instructions.
- 33 B. Use only chemicals allowed by manufacturer's cleaning instructions (no harsh chemicals).

34 **3.3 PROTECTION**

- 35 A. Protect dry erase boards from damage during construction.

36
37 **END OF SECTION**

**SECTION 12 93 00
SITE FURNISHINGS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Bike Rack

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base and foundation construction.

1.3 REFERENCES STANDARDS

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
B. Indicate detailed dimensions, base attachment details, and anchor requirements.
C. Product Data: Provide data on furnishing, equipment, accessories, and configurations.
D. Submit product information and manufacturer's installation recommendations for all site furnishings.

1.5 PRODUCT HANDLING AND STORAGE

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Protect all furnishings, equipment, and accessories from damage or moisture.
C. Replacements: In the event of damage to the site furnishings, immediately make all repairs or replacements necessary to the approval of the Owner and at all no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 BIKE RACK

- A. Manufacturer: Madrax
1080 Uniek Drive
Waunakee, WI 53597
608-849-1080
B. Model No: ORNS-2-SF (Orion Square Rack)
Surface Mount, Color: Black, Powder Coated
C. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install site furnishings as indicated on the Drawings.
B. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.

3.2 EXAMINATION

- A. Verify site is ready to receive work and dimensions are as indicated on shop drawings and as required by manufacturer.
B. Owner and Landscape Architect reserves the right to make minor field adjustments to best fit the exact field conditions.

END OF SECTION

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**SECTION 14 45 00
HEAVY DUTY VEHICLE LIFTS**

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3.2	PREPARATION	5
3.3	INSTALLATION	5
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PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

- A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Scissors style in-ground lifts, 3 post type.
 - 2. All associated equipment and system components.
- B. There are two identical lifts included in the scope of work.
- C. Include manufacturer's floor-mounted controls and include a wired remote accessory with each unit.
- D. The work must be coordinated prior to any concrete work.
- E. Verify control unit location with owner during the pre-installation of concrete phase.

1.3 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.4 REFERENCES

- A. ANSI/ALI ALCTV: 2011 - "Standard for Automotive Lifts - Safety Requirements for Construction, Testing and Validation".
- B. UL 201 - These requirements cover garage equipment, rated not more than 600 volts, for use in accordance with the National Electrical Code, NFPA 70.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Submit drawings showing full layout of all lifts with dimensions and details shown for services and conduits between lifts and the control consoles.
- C. Operation and Maintenance Manual: Submit owner's manual to include system operation, maintenance and troubleshooting, spare part numbers, drawings and schematics.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The manufacturer shall possess ISO-9001 certification.
- B. Installer Qualifications: For warranty validation, installation shall be performed by qualified factory authorized and trained personnel.
- C. Product Requirements:
 - 1. Design Standards and Certification: The lift shall be certified by ETL/Intertek to the ANSI/ALI ALCTV-current edition Standard for Automotive Lifts: Safety Requirements for Construction, Testing and Validation.
 - 2. Drive system shall permit lifting without any pulsation, jerks, or unsteady lifting. Lifting shall be smooth. System shall comprise an electrically powered pump, flow control valves, and a fluid reservoir. An electronic/hydraulic synchronization device shall ensure alignment of each lifting assembly. A microprocessor shall control all lift movement for ultimate operator safety and convenience. Troubleshooting codes shall facilitate service and repair.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's limited 2 year parts and 1 year parts and labor warranty.

PART 2 PRODUCTS

2.1 SCISSORS IN-GROUND LIFTS

- A. Subject to compliance with requirements, provide the following:
 - 1. ECO-90 as manufactured by Stertil-Koni USA Inc.
 - a. General Description: lift shall consist of three lifting units in line with the longitudinal axis of the vehicle, each lifting unit so equipped as to engage the axle and/or suspension as specified herein.
 - b. Lifting Capacity:
 - i. Lift shall be capable of raising 90,000 lbs. (27,216 kg).
 - ii. Unbalanced Loads, Each lift shall be capable of raising 30,000 lbs (13,608 kg) on one unit and 0 lbs (0 kg) on the other unit.
 - c. Travel range for the movable lifting unit is as follows, depending on selected model:
 - i. The basis shall be city-owned double axel and articulated buses (ECO 90).
 - 2. Dimensions:
 - a. Lifting height shall be no less than 70 inches (1,780 mm) as measured from the bolster at full rise to the finished floor.
 - b. Lifting Rate: 90 seconds; 45 inches (1,140 mm) per minute, minimum.
 - c. Maximum depth below finished floor for any structural component or member: 34 inches (864 mm) maximum.
 - d. Movable and fixed lifting unit synchronization: 2 inches (51 mm).
 - e. Lift Units:
 - i. Lift units and continuous recess insert shall be completely removable with no lift components or structural framing permanently embedded in the concrete.
 - ii. Lift unit shall be a hydraulically powered, mechanically articulating scissor lift, complete with a mechanical locking system.

- iii. All steel surfaces shall be powder coated.
 - iv. By means of a centering link, the lifting unit structure shall articulate symmetrically about the center axis of the lift unit as it raises and lowers.
3. Movable Lifting Unit:
- a. Movable lifting unit shall relocate horizontally fore and aft while in the fully retracted position. Total of 3 units.
 - b. When the entire travel frame insert has the covers in place and the lift is operational, it forms a continuous recess that shall meet the following design and performance criteria:
 - i. The movable lifting unit shall not be required to recess, or park, in only one "pocketed" location, providing increased productivity in servicing fleet vehicles of varying wheelbases.
 - ii. The movable lifting unit may be recessed below finished floor at any position between the minimum and maximum dimensions of the travel range.
 - iii. The movable lifting unit shall be capable of fore and aft travel while recessed below floor.
 - c. Maximum depth below finished floor for the continuous recess insert, rear lifting unit or any fixed or movable component shall be 34 inches (864 mm).
 - d. The movable steel box insert shall have an open floor design, mounted off the concrete floor of the trench to allow for the collection, cleaning and drainage of all liquids and solids that accumulate in the trench.
 - e. Aluminum covers for moveable mechanism is anodized structural 6061 aluminum extrusions engineered to accept a 7,500 lb. (3,402 kg) point load on a contact area of 2 x 2 inches (50 x 50 mm) and shaped to include a full-length interlocking hinge. Covers shall fit together tightly and uniformly to promote smooth travel so as to prevent jamming and twisting. Covers shall be able to accept a 13,500 lb. (6,123 kg.) drive over load on a 6 x 9 inch (152 x 228 mm) contact area.
 - f. Aluminum covers for the moveable mechanism are attached to UHMW slider blocks for reduced friction and increased longevity. These slider blocks shall keep the covers properly centered at all times. Horizontal grooves in the UHMW sliders shall, together with essentially half moon shaped guide rails in the end section of lift's steel box insert, securely guide the covers as they travel in and out of the recess.
 - g. Aluminum covers for the moveable mechanism shall be flush with finished floor within a tolerance of less than 1/8 inch. Covers that are lower than the finished floor are not be acceptable.
 - h. Movable lifting unit and the covers shall bear on and slide over UHMW surfaces for low friction and minimal maintenance.
 - i. Hydraulically powered carriage drive shall utilize a rack and gear arrangement on both left and right sides for smooth and even fore-aft travel without binding.
 - j. Rack shall be inverted and positioned under the load channel of the movable lifting unit insert where it is protected so as not to collect dirt, grease etc.
 - k. All hydraulic and compressed air service lines are fed from control console to moveable lifting unit insert through one PVC chase way per unit.
 - l. All low voltage, intrinsically safe electric service lines shall be fed from the control console to the moveable lifting unit insert through one 3/4 inch rigid conduit per unit, installed to meet local requirements.
4. Hydraulic System:
- a. System shall be comprised of high-pressure, low-volume, single-acting, 7 inch (178 mm) diameter cylinders, one in each lifting unit.
 - b. The hydraulic system shall be a power-up / gravity-down design. Lifts that rely on the power units to run during the lowering cycle shall not be acceptable due to increased power consumption.
 - c. High-pressure seals shall be internal to the cylinder, where they are protected from salt, dirt, etc.
 - d. Combined, the two cylinders shall only require 7 gallons (26.5 l) of AW 15 hydraulic oil for lifting to full height.
 - e. Each pistons requires 3.5 gallons (13.25 Liters) of hydraulic oil for lifting to full height.
 - f. Each cylinder shall have a hose break velocity fuse (safety check valve) integrally mounted to prevent excessive loss of fluid from the cylinder.
 - g. The hoses shall be of reinforced construction and utilize JIC fittings throughout.
 - h. The hoses feeding the front movable lift carriage shall be supported and contained by a cable

- carrier to prevent the hoses from dragging or tangling.
 - i. The lift shall be driven by two individual power units, readily available as an off-the-shelf component.
- 5. Adapters:
 - a. The lift system shall include a variety of axle engaging accessory adapters designed to raise heavy vehicles by the axles or chassis. The accessory adapters shall be easily removed for storage and/or change out.
 - b. Adapter Adjustment: Minimum 13.25 inches (337 mm); Maximum 56 inches (1422 mm).
 - c. Bolster Width: 40 inches (1016 mm) minimum.
 - d. Bolster and Base Adapters for all lifting units shall recess below finished floor.
 - e. Base adapters shall be restrained to prevent over extension.
 - f. Removal of base adapters shall be accomplished by pulling-up a spring loaded pin and sliding the base adapter off the bolster.
 - g. The base adapter shall have at least a five hole pattern that will allow every accessory adapter to be used in the reverse direction, allowing up to eight positions of the accessory adapter on the base adapter.
- 6. Controls:
 - a. The control system shall conform to all current NEC, UL 201 and OSHA codes.
 - b. The control system shall be PCB operated and continuously monitor all operating functions and safety systems of the lifting units. The control system shall utilize intrinsically safe inclinometers to constantly monitor the elevation of the lifting units to ensure synchronized operation. Synchronization through flow control valves is not acceptable. Control systems that do not constantly monitor the elevation of all lifting units are not acceptable.
 - c. The control system shall have a provision to allow the operator to electronically restrict the maximum lifting height.
 - d. The control system shall provide audio and visual feedback that communicates with the operator. The control system shall facilitate troubleshooting by providing no less than 44 fault codes displayed in numeric fashion on the PCB.
 - e. The enclosure for electrical control components shall be IP 54 rated and have the following controls mounted on the front cover
 - i. Disconnect switch, 460/480 - 3 phase
 - ii. Push buttons for Lift Raise, Lower and Unlock
 - iii. Selector button for synchronized, moveable, or fixed lifting
 - iv. Push buttons for hydraulic moveable carriage drive
 - f. Include as a part of the control system are accessory remote switches which are wired and attached to the main control module. This remote will operate the lift from afar and includes 8 buttons to lift, stop and control the lift. The remote shall include 30' long cords. This is attached to the main module just below the stop button. Total of 2, one for each module.
 - g. The control console shall be equipped with a main power disconnect switch which interrupts all incoming power. Main power disconnect shall be lock-out capable.
 - h. Console access panels shall have key-hole slots and recessed handles for easy removal and installation.
 - i. The control system shall include, on the control box face, a blue HOME indicator lamp. This lamp shall illuminate when all lifting units are fully retracted to inform the operator that the bay is clear to allow entry and exit by the vehicle.
 - j. The control system shall automatically prohibit horizontal movement of the moveable lifting unit when raised above 12 inches A.F.F.
 - k. The control system shall have a provision to allow the operator to open the mechanical locks during rising to reduce noise emission.
 - l. The lift, when fitted with the proper electrical motor, shall operate at the following voltages: 4 (3 phase).
- 7. Safety Devices:
 - a. Each lifting unit shall be equipped with double lock jaw, gravity engaging, mechanical locks with the first lock position engaging at a minimum height of 18 inches (457 mm).
 - b. Number of Mechanical Lock Stops: 12, minimum.
 - c. Vertical height spacing between each lock stop: 6 inches (152 mm), maximum.
 - d. The mechanical locks shall be made of high strength T-1 steel.
 - e. All push buttons shall be of momentary contact, dead man type.

- f. Unit shall be automatically engaged at all times when lift is not operating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until supporting structures have been properly prepared.
- B. If supporting structures preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Carefully coordinate the installation of the lifts, controls, underground piping and related work prior to the installation of the concrete floor.
- B. Contractor shall hold a pre-construction meeting with all sub-contractors including lift manufacturer, concrete, electrical and mechanical contractors.**
- C. Clean surfaces thoroughly prior to installation.
- D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- E. Refer to the drawings and advise the Architect of any conditions of concern.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Test for proper operation, and re-test if necessary until satisfactory results are obtained.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SECTIONS

- A. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Quality Assurance
 - 6. Electrical Coordination
 - 7. Protection of Finished Surfaces
 - 8. Sleeves and Openings
 - 9. Sealing and Fire Stopping
 - 10. Off Site Storage
 - 11. Codes
 - 12. Design Criteria
 - 13. Certificates and Inspections
 - 14. Submittals
 - 15. Operating and Maintenance Instructions
 - 16. Training of Owner Personnel
 - 17. Record Documents
- B. PART 2 - PRODUCTS
 - 1. Access Panels and Doors
 - 2. Identification
 - 3. Sealing and Fire Stopping
- C. PART 3 - EXECUTION
 - 1. Concrete Work
 - 2. Cutting and Patching
 - 3. Building Access
 - 4. Equipment Access
 - 5. Coordination
 - 6. Identification
 - 7. Lubrication
 - 8. Sleeves and Openings
 - 9. Sealing and Fire Stopping
 - 10. Construction Verification Items
 - 11. Agency Training

1.2 SCOPE

- A. This section includes information common to two or more technical fire protection specification sections or items that are of a general nature, not conveniently fitting into other technical sections.
- B. The specifications and drawings are scope documents based on the Owner's requirements for the fire protection systems. It is the intent of the documents to detail and specify the minimum requirements and components. It is the responsibility of the Contractor to design and install a complete fire protection system in compliance with NFPA, State, and the Local Authority Having Jurisdiction codes and requirements. Pipe and equipment sizing shown in the documents is the minimum allowed. If larger size is required, it is to be included in the bid.

1.3 RELATED WORK

- A. This section applies to all Division 21 sections of fire suppression.
 - 1. Section 07 84 00 Fire Stopping

1.4 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1
2 **1.5 REFERENCE STANDARDS**

- 3 A. Abbreviations of standards organizations referenced in this and other sections are as follows:
- 4 1. ANSI American National Standards Institute
 - 5 2. ASME American Society of Mechanical Engineers
 - 6 3. ASTM American Society for Testing and Materials
 - 7 4. AWWA American Water Works Association
 - 8 5. AWS American Welding Society
 - 9 6. CGA Compressed Gas Association
 - 10 7. CS Commercial Standards, Products Standards Sections, Office of Engineering Standards Service
 - 11 8. EPA Environmental Protection Agency
 - 12 9. FM FM Global
 - 13 10. FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
 - 14 11. IAPMO International Association of Plumbing & Mechanical Officials
 - 15 12. IEEE Institute of Electrical and Electronics Engineers
 - 16 13. ISA Instrument Society of America
 - 17 14. DSPS State of Wisconsin Dept. of Safety and Professional Services
 - 18 15. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
 - 19 16. NBS National Bureau of Standards
 - 20 17. NEC National Electric Code
 - 21 18. NEMA National Electrical Manufacturers Association
 - 22 19. NFPA National Fire Protection Association
 - 23 20. STI Steel Tank Institute
 - 24 21. UL Underwriters Laboratories Inc.

25
26 **1.6 QUALITY ASSURANCE**

- 27 A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- 28 B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and
- 29 materials are not to be reused unless specifically indicated. The use of a manufacturer's name, model, or catalog
- 30 number, as scheduled or specified, is for the purpose of establishing the standard of quality and general configuration.
- 31 Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or
- 32 engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs
- 33 involved in integrating the equipment or accessories into the system and for obtaining the performance from the
- 34 system into which these items are placed. Said costs may include, but are not limited to, modifications for:
- 35 1. Structural loading
 - 36 2. Size
 - 37 3. Maintenance accessibility
 - 38 4. Electrical or plumbing connections
 - 39 5. Finish
 - 40 6. Performance and efficiency
 - 41 7. Warranty
 - 42 8. Changes found necessary during the testing, adjusting, and balancing phase of the project

43
44 **1.7 ELECTRICAL COORDINATION**

- 45 A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical
- 46 equipment are furnished by the Electrical Contractor, except as specifically noted elsewhere in this division of
- 47 specifications.
- 48
- 49 B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this
- 50 Contractor. Should any change in size, horsepower rating or means of control be made to any motor or other
- 51 electrical equipment after contracts are awarded, Contractor is to immediately notify the Electrical Contractor of this
- 52 change and pay any costs due to this change.
- 53 C. Electrical Contractor will provide all power wiring and the Fire Protection Contractor shall provide all control wiring.
- 54 Control wiring shall conform to Division 28 requirements for Control Wiring.
- 55 D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and
- 56 indicated to be wired by the Electrical Contractor.
- 57

1 **1.8 PROTECTION OF FINISHED SURFACES**

2 A. Refer to Division 1, General Requirements, Protection of Finished Construction.

4 **1.9 SLEEVES AND OPENINGS**

5 A. Refer to Division 1, General Requirements, Sleeves and Openings.

7 **1.10 SEALING AND FIRESTOPPING**

8 A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the
9 responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals
10 skilled in such work to do the sealing and fireproofing. Provide all fire stopping of fire rated penetrations and sealing
11 of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

13 **1.11 OFF SITE STORAGE**

14 A. Prior approval by Owner's Representative and the A/E will be needed. The contractor shall submit a Storage
15 Agreement Form to Owner's Representative for consideration of off-site materials storage. Generally, sleeves,
16 pipe/pipe fittings and similar rough-in material will not be accepted for off-site storage. No material will be accepted
17 for off-site storage unless shop drawings for the material have been approved.

19 **1.12 CODES**

20 A. Comply with requirements of Wisconsin Administrative Code, Dept. of Safety and Professional Services, NFPA
21 Standards and local Fire Chief or Fire Marshal (AHJ, Authority Having Jurisdiction) regarding design, materials and
22 installation.

24 **1.13 DESIGN CRITERIA**

25 A. Design fire protection systems in accordance with codes, standards and regulations noted above.

26
27 B. Hydraulically design system for the most remote area based on the following:

Location	Occupancy Classification	Area (SqFt)	Density (GPM/SqFt)
General Offices	Light Hazard	1500	0.10
Bathrooms	Light Hazard	1500	0.10
Janitor Rooms	Ordinary Hazard - Group 1	1500	0.15
Mechanical Rooms	Ordinary Hazard – Group1	1500	0.15
Storage Rooms	Ordinary Hazard – Group 1	1500	0.15
Bus Storage	Extra Hazard – Group 1	2500	0.30
Battery Storage	Extra Hazard – Group 1	2500	0.30
Rack Storage	Extra Hazard – Group 1	2500	0.60
Tire Storage	Extra Hazard – Group 1	2500	0.60

39
40 C. Remote area increases for dry and preaction systems and other circumstances i.e. sloped or higher ceilings are to be
41 added to the minimum remote areas noted above as required by code. Remote area reduction for use of quick
42 response sprinkler heads is not allowed without prior approval of the A/E and Owner's Representative.

43 1. Available water supply data for system design is as follows:

44
45 Building: 3829 Hanson Road – Maintenance Building

46 Test Date and Time: July 6, 2022

47 Performed By: HJ Pertzborn

48
49 Main Drain Test:

50 Static: 79 PSI

51 Residual: 66 PSI

1 Hydraulic Data:
2 Occupancy Classification: Ordinary Hazard Group II
3 Density: 0.20 gpm/ft²
4 Area of Application: 1950 ft²
5 Coverage per Sprinkler: 256 ft²
6 System Requirements: 520.49 gpm at 66 psi
7 Safety Margin: 17.40 psi
8

9 Building: 3901 Hanson Road – Bus Storage Building
10 Test Date and Time: July 6, 2022
11 Performed By: HJ Pertzborn
12

13 Main Drain Test:
14 Static: 81 PSI
15 Residual: 73 PSI
16

17 Hydraulic Data:
18 Occupancy Classification: Ordinary Hazard Group II
19 Density: 0.20 gpm/ft²
20 Area of Application: 2020 ft²
21 Coverage per Sprinkler: 252 ft²
22 System Requirements: 530.92 gpm at 61.301 psi
23

24 D. Water test data is preliminary for bidding purposes. Verify and obtain any additional test data required for design.
25 Tests to be representative of high water use periods.
26

27 **1.14 CERTIFICATES AND INSPECTIONS**

- 28 A. Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.
29
30 B. Obtain and pay for all required State or local installation inspections except those provided by the Architect/Engineer.
31 Deliver originals of NFPA test certificates and test reports to the Division's construction representative. Include copies
32 of the certificates and reports in the Operating and Maintenance Instructions.
33

34 **1.15 SUBMITTALS**

- 35 A. Refer to Section GC - General Conditions of the Contract, Submittals.
36
37 B. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list
38 page showing item designation, manufacturer and additional items supplied with the installation. Submit for all
39 equipment and systems as indicated in the respective specification sections, marking each submittal with that
40 specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted
41 and proper identification of equipment by name and/or number, as indicated in the contract documents. Include
42 wiring diagrams of electrically powered equipment.
43
44 C. The specific items that will be required for submittals shall be coordinated with the Owner's Project Representative,
45 the A/E, and the General Prime Contractor for inclusion in the project submittal log.
46
47 D. Plan submittal for review and approval to the Department of Safety and Professional services is required for all state
48 buildings with the exception of the replacement in kind of equipment and projects that include 20 or fewer sprinkler
49 heads. Licensed health care facilities require submittal and approval from the Department of Health Services.
50 Submittals shall be sent to the local Fire Chief or Fire Marshal for review prior to the Architect/Engineer. Include a
51 copy of all review/approval letters in submission to Architect/Engineer.
52
53 E. Submit plans indicating water supply location and size, piping layout and size, sprinkler locations and type, hanger
54 locations and type, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference
55 points, design areas and discharge densities.
56

1 F. Submit hydraulic calculations for water supply and sprinkler and standpipe systems. Include summary sheet and
2 detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations.
3 Include graph illustration of water supply, hose demand, sprinkler demand and in-rack sprinkler demand. Where a
4 fire pump is used, graph primary rating point, secondary rating point and churn pressure of pump and combined
5 water supply.

6
7 G. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:

- | | | |
|----|---------------------------------------|----------|
| 8 | 1. Operating and Maintenance Manuals | 2 copies |
| 9 | 2. Division of Facilities Development | 1 copy |
| 10 | 3. Architect/Engineer | 1 copy |
| 11 | 4. Local Fire Chief or Marshal | 1 copy |

12
13 **1.16 OPERATING AND MAINTENANCE INSTRUCTIONS**

14 A. All operations and maintenance data shall comply with the submission and content requirements specified under
15 section GENERAL REQUIREMENTS.

16
17 B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
18 documentation:

- 19 1. Copies of all approved submittals along with approval letters.
- 20 2. Manufacturer's wiring diagrams for electrically powered equipment.
- 21 3. Records of tests performed to certify compliance with system requirements.
- 22 4. Certificates of inspection by regulatory agencies.
- 23 5. Parts lists for equipment and specialties.
- 24 6. Manufacturers installation, operation and maintenance recommendations for equipment and specialties.
- 25 7. Valve schedules
- 26 8. Lubrication instructions, including list/frequency of lubrication
- 27 9. Warranties
- 28 10. CAD files of the Contractor installation plans compatible with AutoCAD
- 29 11. Additional information as indicated in the technical specification sections

30
31 **1.17 TRAINING OF OWNER PERSONNEL**

32 A. Instruct Owner's personnel in the proper operation, maintenance and testing of systems and equipment provided as
33 part of this project. Include not less than 2 hours of instruction, using the Operating and Maintenance manuals and
34 record drawings during this instruction. Demonstrate testing, startup and shutdown procedures for all equipment.
35 All training to be during normal working hours. Video record all instructions and provide Owner with copy.

36
37 **1.18 RECORD DOCUMENTS**

38 A. Refer to Division 1, General Requirements, Record Documents.

39
40 B. In addition to the data indicated in the General Requirements, maintain fire protection layout record drawings and
41 hydraulic calculations on originals prepared by the installing contractor/subcontractor. Include copies of these record
42 drawings and calculations with the Operating and Maintenance manuals.

43 **PART 2 - PRODUCTS**

44 **2.1 ACCESS PANELS AND DOORS**

45 A. LAY-IN CEILINGS:

- 46 1. Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Division 09 are sufficient;
47 no additional access provisions are required unless specifically indicated.

48
49 B. MASONRY WALLS, GYPSUM BOARD AND Plaster Walls and Ceilings:

- 50 1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications,
51 stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam
52 latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if
53 required by the application. Use the largest size access opening possible, consistent with the space and the
54 equipment needing service; minimum size is 12" by 12".

- 1 **2.2 IDENTIFICATION**
2 A. ADHESIVE LABELS:
3 1. Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, 3/4" min. size for white
4 lettering and surrounding red background tape on both ends with flow arrows on piping. Conforming to ANSI,
5 ASME A.13-2007 and NFPA standards. Seton Opti-Code, MSI, Brady or approved equal. Clean piping before
6 application.
7 B. SIGNS:
8 1. Metal construction, baked porcelain enamel finish signs, sizes conforming to NFPA no. 13 and 7-1.2, with
9 holes and s-hooks/chains for hanging or securing. With applicable labeling. MSI, Seton, W.H. Brady or equal.
10
11 **2.3 ENGRAVED NAME PLATES**
12 A. White letters on a red background, 1/16" thick plastic laminate, beveled edges, screw mounting, Seton ply Style 2060
13 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.
14
15 **2.4 VALVE TAGS**
16 A. Round brass tags with 1/2" numbers, 1/4" system identification abbreviation, 1-1/4" minimum diameter, with brass
17 jack chains with brass "S" hooks or one piece nylon ties around the valve stem, available from EMED Co., Seton Name
18 Plate Company, MSI or W. H. Brady.
19
20 **2.5 SEALING AND FIRE STOPPING**
21 A. FIRE AND/OR SMOKE RATED PENETRATIONS:
22 1. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with
23 section 07 84 00 "Fire Stopping".
24
25 B. NON-RATED PENETRATIONS:
26 1. Pipe Penetrations:
27 a. At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use
28 urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster
29 or wood partitions where sleeve is not required, use urethane caulk in annular space between pipe
30 insulation and wall material.

31 **PART 3 - EXECUTION**

- 32 **3.1 CONCRETE WORK**
33 A. Provide cast in place concrete for equipment pads and pump bases. Concrete to be 3,000 psi at 28 days, 3/4 inch
34 aggregate, five bags cement, three inch slump, air entraining admixture. The ACI 614 Recommended Practice for
35 Measuring, Mixing and Placing of Concrete shall constitute the execution requirements.
36
37 **3.2 CUTTING AND PATCHING**
38 A. Refer to Division 1, General Requirements, Cutting and Patching
39
40 **3.3 BUILDING ACCESS**
41 A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access
42 was not previously arranged and must be provided by this contractor, restore any opening to its original condition
43 after the apparatus has been brought into the building.
44
45 **3.4 EQUIPMENT ACCESS**
46 A. Install all piping, conduit and accessories to permit access to equipment for maintenance and service. Coordinate the
47 exact location of wall and ceiling access panels and doors with the General Prime Contractor, making sure that access
48 is available for all equipment and specialties. Access doors in general construction are to be furnished by the Fire
49 Protection Contractor and installed by the General Prime Contractor.
50
51 B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not
52 require access panels.
53

1 **3.5 COORDINATION**

- 2 A. Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that interferes
3 with other contractor's work shall be removed or relocated at the installing contractor's expense.
4
5 B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.
6

7 **3.6 IDENTIFICATION**

- 8 A. Identify equipment in mechanical equipment rooms with engraved name plates as specified in Part 2 - Products.
9 Equipment shall be designated with the contract drawings designation and description. Example: FP – 1 Fire Pump.
10
11 B. Identify interior piping not less than once every 25 feet, not less than once in each room, adjacent to each access
12 door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Place flow
13 directional arrows at each pipe identification location. Use approved pipe marking label systems, or provide snap-
14 around type pipe markers as specified in Part 2 – Products.
15
16 C. Identify all valves, fire department connections, anti-freeze systems, and risers with signs per NFPA rulings. Brass
17 valve tags are also required as outlined in Part 2 – Products.
18
19 D. Provide hydraulic design information sign of permanently marked weatherproof metal or engraved nameplate
20 material. Secure to alarm valve with brass chain. Information to include location of the design areas, discharge
21 densities, required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.
22
23 E. Provide a framed valve chart in the main mechanical equipment room or at the fire pump (where applicable). Chart
24 shall include valve size, location, and function.
25
26 F. Provide additional valve chart and CD in close out documentation.

27 **3.7 LUBRICATION**

- 28 A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any
29 reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions
30 until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication; include
31 this information in the Operating and Maintenance Manuals at the completion of the project.
32

33 **3.8 SLEEVES AND OPENINGS**

- 34 A. Pipe penetrations in existing concrete floors: Core drill openings.
35
36 B. Pipe penetrations through existing floors located in food service areas that do not require a T rating:
37
38 C. Core drill sleeve opening large enough to insert schedule 40 sleeve, extend sleeve 2 inches above the floor and grout
39 area around sleeve with hydraulic setting, non-shrink grout. Size sleeve to allow insulated pipe to run through sleeve
40 and paint the sleeve.
41
42 D. Where penetrating pipe or conduit weight is supported by floor, provide manufactured product or structural bearing
43 collar designed to carry load.
44

45 **3.9 SEALING AND FIRE STOPPING**

- 46 A. FIRE AND/OR SMOKE RATED PENETRATIONS:
47 1. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with
48 section 07 84 00 Fire Stopping.
49
50 B. NON-RATED PARTITIONS:
51 1. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both
52 sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening
53 and the pipe or insulation is completely blocked.
54
55 C. PENETRATIONS SUBJECT TO WATER INTRUSION:
56 1. For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical
57 equipment (but not within walls) provide one of the following:
58 a. Pipe penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.

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- b. Pipe penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above the floor (provided it meets the device's UL listing).
 - c. Pipe penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2"x 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten angles to floor minimum 8" on center. Seal corners water tight with urethane caulk.
2. Floors subject to water intrusion or rooms housing electrical equipment include the following locations:
- a. Janitor Rooms w/ Sinks
 - b. Mechanical/Plumbing Equipment Rooms
- D. Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the fire stopping system from water) in areas subject to wash down such as Food Service and Dish Washing Areas.

3.10 AGENCY TRAINING

- A. All training provided for agency shall comply with the format, general content requirements and submission guidelines.
- END OF SECTION 210500

**SECTION 21 05 29
HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT**

PART 1 - GENERAL

1.1 SECTIONS

- A. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Quality Assurance
 - 6. Description
 - 7. Shop Drawings
 - 8. Design Criteria
- B. PART 2 - PRODUCTS
 - 1. Manufacturers
 - 2. Pipe Hangers and Supports
 - 3. Pipe Hanger Rods
 - 4. Beam Clamps
 - 5. Riser Clamps
 - 6. Drilled Fasteners
 - 7. Corrosive Atmosphere Coatings
- C. PART 3 - EXECUTION
 - 1. Installation
 - 2. Hanger and Support Spacing
 - 3. Riser Clamps
 - 4. Drilled Fasteners

1.2 SCOPE

- A. This section includes specifications for support of all fire suppression equipment and materials as well as piping system anchors. Included are the following topics:

1.3 RELATED WORK

- A. Section 03 10 00 & 03 30 00 Concrete Forming and Accessories and Cast – In – Place Concrete
- B. Section 21 10 00 Water-Based Fire Suppression Systems

1.4 REFERENCE

- A. Applicable provisions of Division 1 shall govern work under this section.

1.5 REFERENCE STANDARDS

- A. MSS SP-58
- B. NFPA 13 Installation of Sprinkler Systems (Latest prevailing edition).
- C. UL Underwriters' Laboratories Listed.
- D. FM Factory Mutual Approved

1.6 QUALITY ASSURANCE

- A. Substitution of Materials Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

1.7 DESCRIPTION

- A. Provide all supporting devices as required for the installation of fire suppression equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.
- B. Do not hang any fire suppression system item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.
- C. Fasteners depending on soft lead for holding power or requiring explosive powder actuation will not be accepted.

1
2 D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of
3 equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
4

5 **1.8 SHOP DRAWINGS**

6 A. Schedule all hanger and support devices indicating attachment method and type of device for each pipe size and type
7 of service. Provide details on the working drawings submitted for approval with all pertinent information listed.
8

9 **1.9 DESIGN CRITERIA**

10 A. Materials and application of pipe hangers and supports shall be in accordance with MSS SP-58 Pipe Hangers and
11 Supports – Materials, Design, Manufacture, Selection, Application and Installation unless noted otherwise.
12

13 B. Materials and application of pipe hangers and supports shall be in accordance with NFPA rulings and be UL/FM listed
14 and approved.
15

16 C. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation
17 supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is
18 greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3
19 support distance.

20 **PART 2 - PRODUCTS**

21 **2.1 MANUFACTURERS**

22 A. B-Line, Anvil, Erico, G-Strut, Tolco, or Engineer approved equal.
23

24 **2.2 PIPE HANGERS AND SUPPORTS**

25 A. HANGERS FOR PIPE SIZES 1/2" THROUGH 4":

26 1. Carbon steel, adjustable swivel ring with 3/8" min. UL/FM approved hanger rods. B-Line B3170NF, Anvil 69
27 or 70.
28

29 2. Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.
30

31 B. HANGERS FOR PIPE SIZES 4" THROUGH 8":

32 1. Carbon steel adjustable swivel ring with 1/2" min. UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or
33 70.
34

35 2. Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.
36

37 C. MULTIPLE OR TRAPEZE HANGERS:

38 1. Manufactured steel channel system with manufacturers slotted interlocking pipe clamps with screw/nut
39 securing and threaded hanger rods or steel channels with welded spacers and threaded hanger rods.
40

41 D. Wall Support:

42 1. Carbon steel welded bracket with hanger. B-Line 3060 Series, Anvil 190 Series. Steel channels with pipe
43 clamps.
44

45 E. VERTICAL SUPPORT:

46 1. Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.
47

48 F. FLOOR SUPPORT:

49 1. Carbon steel pipe saddle stand and bolted floor flange. B-Line B3088T/B3093.
50

1 **2.3 PIPE HANGER RODS**

2 A. Steel Hanger Rods:

- 3 1. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
4 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.

5

<u>Pipe Size</u>	<u>Diam. Of Rod</u>
6 Up to and	
7 Including 4"	3/8" or 9.5mm min.
8	
9 5",6" and 8"	½" or 12.7mm min.

10

11

12 **2.4 BEAM CLAMPS**

13 A. MSS SP-58 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a
14 retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw.
15 B-Line B3036L/B3034, Anvil 86/92.

16

17 B. MSS SP-58 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes
18 to 1-1/2 inch diameter. B-Line B3054, Anvil 228.

19

20 **2.5 DRILLED FASTENERS:**

21 A. Concrete construction

- 22 1. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same
23 manufacturer as anchor. Hilti, Rawl, Redhead.

24

25 **2.6 CORROSIVE ATMOSPHERE COATINGS**

26 A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM
27 A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0
28 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory
29 coating.

30

31 B. Corrosive atmospheres include the following locations:

- 32 1. Exterior locations
33 2. Parking Ramps
34 3. Chemical storage and hazardous waste storage rooms
35 4. Locker rooms

36 **PART 3 - EXECUTION**

37 **3.1 INSTALLATION**

38 A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.

39

40 B. Install supports to provide for free expansion of the piping system. Support all piping from the structure using
41 concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets
42 securely to the structure and test to demonstrate the adequacy of the fastening.

43

44 C. Coordinate hanger and support installation to properly group piping of all trades.

45

46 D. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes
47 or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting
48 devices made specifically for use with the channels may be substituted for the specified supporting devices provided
49 that similar types are used and all data is submitted for prior approval.

50

51 E. Perform welding in accordance with standards of the American Welding Society.

52

53 **3.2 HANGER AND SUPPORT SPACING**

54 A. Use hangers with minimum vertical adjustment.

1
2 B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

3
4 C. Support riser piping independently of connected horizontal piping.

5
6 D. Adjust hangers to obtain the slope specified in the piping section of these specifications.

7 1. Space hangers for pipe as follows:

8	9	10	11	12
	Pipe Material	Pipe Size	Max. Horiz. Spacing	Max. Vert. Spacing
	Steel	1" through 1-1/4"	12'-0"	15'-0"
	Steel	1-1/2" through 8"	15'-0"	15'-0"

11
12 E. Restraint hangers shall be installed at all sprinkler head location within 1'-0" for a single restraint and within
13 5'-0" for two points of restraint. The requirements for hanger restraint for systems in excess of 100 PSI
14 pressure shall be followed.

15
16 F. Unsupported length from the last hanger and an end sprinkler for steel piping systems shall be as follows:

17	1" piping	Not greater than 36"
18	1-1/4" piping	Not greater than 48"
19	1-1/2" piping	Not greater than 60"
20	or larger.	

21
22 **3.3 RISER CLAMPS**

23 A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the
24 building structure below at each floor. Use method of securing the vertical risers to the building structure below in
25 stairwell locations.

26
27 **3.4 Drilled Fasteners**

28 A. Select size based on NFPA 13 pipe size rod requirements. Use inserts for suspending hangers from reinforced concrete
29 slabs and sides of reinforced concrete beams. Follow manufacturer requirements for drill size and hole depth. Where
30 concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

31 END OF SECTION 210529

SECTION 21 10 00
WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SECTIONS

- A. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Shop Drawings
 - 6. Quality Assurance
 - 7. Delivery, Storage, and Handling
 - 8. Design Criteria
 - 9. Welder Qualifications
 - 10. Electrical Coordination
- B. PART 2 - PRODUCTS
 - 1. Fire suppression Piping
 - 2. Unions and Flanges
 - 3. Mechanical Grooved Pipe Connections
 - 4. Sprinkler Heads
 - 5. Flexible Sprinkler Drop Fittings
 - 6. Flow Switches
 - 7. Local Alarm
 - 8. Pressure Gauges
 - 9. Valves
 - 10. Specialty Valves
 - 11. Fire Department Connection
 - 12. Fire Pump Test Connection
- C. PART 3 – EXECUTION
 - 1. General
 - 2. Preparation
 - 3. Erection
 - 4. Welded Pipe Joints
 - 5. Threaded Pipe Joints
 - 6. Mechanical Grooved Pipe Connections
 - 7. Unions and Flanges
 - 8. Piping System Leak Tests
 - 9. Underground Water Main Flushing
 - 10. Installation

1.2 SCOPE

- A. This section contains specifications for fire suppression pipe and pipe fittings for this project.

1.3 RELATED WORK

- A. Section 21 05 00 – Common Work Results for Fire Suppression
- B. Section 21 05 29 – Hangers and Supports for Fire Suppression Piping and Equipment
- C. Division 26 00 00 – Electrical

1.4 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

- 1 **1.5 REFERENCE STANDARDS**
- 2 A. ANSI A21.4
- 3 B. ANSI A21.11
- 4 C. ANSI A21.51
- 5 D. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings
- 6 E. ANSI B16.3 Malleable and Ductile Iron Threaded Fittings
- 7 F. ANSI B16.4 Cast Iron Threaded Fittings
- 8 G. ANSI B16.5 Pipe Flanges and Flanged Fittings
- 9 H. ANSI B16.9 Factory Made Wrought Steel Butt Weld Fittings
- 10 I. ANSI B16.11 Forged Steel Fittings, Socket Welded and Threaded
- 11 J. ANSI B16.18 Cast Bronze Solder Joint Pressure Fittings
- 12 K. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- 13 L. ASTM A105 Forgings, Carbon Steel, for Piping Components
- 14 M. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
- 15 N. ASTM A135 Electric Resistance Welded Steel Pipe
- 16 O. ASTM A181 Forgings, Carbon Steel for General Purpose Piping
- 17 P. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- 18 Q. ASTM A536 Ductile Iron Castings
- 19 R. ASTM A795 Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection
- 20 Use
- 21 S. AWS A5.8 Brazing Filler Metal
- 22 T. AWS D10.9 Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR3
- 23 U. NFPA 13 Installation of Sprinkler Systems. (Latest prevailing edition)
- 24 V. NFPA 71 Installation, maintenance, and use of signaling systems for central station service (Latest prevailing
- 25 edition)
- 26 W. NFPA 72 Installation, maintenance, and use of protective signaling systems (Latest prevailing edition)
- 27 X. UL Underwriters' Laboratories Listing
- 28 Y. FM Factory Mutual Approval
- 29
- 30 **1.6 SHOP DRAWINGS**
- 31 A. Schedule from the contractor indicating the ANSI/ASTM specification number of the pipe being proposed along with
- 32 its type and grade, if known at the time of submittal, and sufficient information to indicate the type and rating of
- 33 fittings for each service.
- 34
- 35 **1.7 QUALITY ASSURANCE**
- 36 A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
- 37
- 38 B. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each
- 39 shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- 40
- 41 C. Any installed material not meeting the specification requirements must be replaced with material that meets these
- 42 specifications without additional cost to the Owner.
- 43
- 44 **1.8 DELIVERY, STORAGE, AND HANDLING**
- 45 A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- 46
- 47 B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not
- 48 store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are
- 49 provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage
- 50 inside or by durable, waterproof, above ground packaging.
- 51
- 52 C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- 53
- 54 D. Storage and protection methods must allow inspection to verify products.
- 55

1 **1.9 DESIGN CRITERIA**

- 2 A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed
3 in this specification.
4
5 B. Construct all piping systems for the highest pressures and temperatures in the respective system but not less than
6 175 psig.
7
8 C. Where weld fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
9
10 D. Where mechanical grooved fittings are used, use only ASTM standard radius fittings, short radius grooved fittings are
11 allowed if system is hydraulically calculated for use.
12
13 E. Where ASTM A53 or A795 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at
14 Contractor's option. Where ASTM A135 grade A pipe is specified, grade B pipe may be substituted at Contractor's
15 option. Where the grade or type is not specified, Contractor may choose from those commercially available.

16
17 **1.10 WELDER QUALIFICATIONS**

- 18 A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified
19 welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services
20 Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic
21 welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the
22 Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.
23
24 B. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the Owner's
25 expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further
26 welding on the project and all defective welds replaced.

27
28 **1.11 ELECTRICAL COORDINATION**

- 29 A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical
30 equipment are furnished by the Electrical Contractor, except as specifically noted elsewhere in this division of
31 specifications.
32
33 B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this
34 Contractor. Should any change in size, horsepower rating or means of control be made to any motor or other
35 electrical equipment after contracts are awarded, Contractor is to immediately notify the Electrical Contractor of this
36 change and pay any costs due to this change.
37
38 C. Electrical Contractor will provide all power wiring and the Fire Protection Contractor shall provide all control wiring.
39 Control wiring shall conform to Division 28 requirements for Control Wiring.
40
41 D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and
42 indicated to be wired by the Electrical Contractor.

43 **PART 2 - PRODUCTS**

44 **2.1 FIRE SUPPRESSION PIPING**

- 45 A. Steel Pipe:
46 1. Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for
47 fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.
48
49 B. PIPE WALL THICKNESS:
50 1. Threaded pipe shall have a minimum wall thickness of schedule 40.
51
52 2. All other pipe shall have a minimum wall thickness of schedule 10. Piping 2" and under shall be minimum
53 schedule 40 unless stated otherwise herein. All pipe utilized in dry systems to be galvanized schedule 40 and
54 schedule 10.

1 C. FITTINGS:

- 2 1. Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable and ductile iron threaded
3 fittings, Class 150 or 300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM
4 A234 grade, ANSI B16.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47
5 malleable iron or ASTM A53 fabricated steel. For wet pipe systems mechanical tee fittings with full iron back
6 equal to Grinnell Figure 730 will be allowed only as needed for connection to existing systems. Outlets for
7 drypipe and preaction systems shall be mechanical tees.
8
9 2. Mechanical tees with U-bolt back or other fastening means are not allowed.
10
11 3. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding
12 materials.
13
14 4. Finish: Hot dipped zinc coated (galvanized) finish on piping and fittings shall be used in drypipe and pre-action
15 systems, piping exposed to weather and piping exposed to corrosive environments where indicated. Thread
16 or grooved hot dipped zinc coated pipe ends for fitting connections. Indoor dry standpipe systems supplied
17 by a Fire Dept. connection only may be black steel piping and fittings.
18

19 D. CPVC PIPE:

- 20 1. Plastic pipe and fittings will not be allowed for this project.
21

22 **2.2 UNIONS AND FLANGES**

23 A. 2" and Smaller Steel:

- 24 1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping
25 and galvanized malleable iron on galvanized steel piping. Grooved couplings may be used in lieu of unions.
26

27 B. 2-1/2" and Larger:

- 28 1. ASTM A181 or A105, Class 150, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern
29 on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded
30 flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat
31 ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face
32 flanges on equipment.
33

34 **2.3 MECHANICAL GROOVED PIPE CONNECTIONS**

- 35 A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Anvil, or Grinnell may be
36 used with steel pipe. Mechanical grooved components and assemblies to be for minimum 175 psi working pressure
37 unless noted otherwise.
38
39 B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters shall be from the same
40 manufacturer.
41
42 C. Couplings and fittings to be malleable iron, ASTM A47, or ductile iron A536 with painted finish. Fittings used on
43 galvanized steel pipe to have galvanized finish, ASTM A153.
44
45 D. Gaskets to be EPDM, ASTM D2000. Gaskets for dry systems to be flush seal design. Heat treated carbon steel oval
46 neck track bolts and nuts, ASTM A-183, with zinc electroplated finish.
47
48 E. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges
49 shall be used.
50
51 F. Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints or flexible
52 connectors may be allowed upon specific application by the Contractor. Three flexible couplings at first three
53 connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for
54 expansion joints shall be made in writing and shall include service, location, line size, proposed application and
55 supporting calculations for the intended service.

1 **2.4 SPRINKLER HEADS**

- 2 A. Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following
3 manufacturers determined to be equal by the Architect/Engineer will be accepted: Tyco, Reliable, Victaulic, Viking
4 and Globe.
5
6 B. Standard coverage sprinkler heads are to be the basis for design unless noted otherwise on the plans or within these
7 specifications. Extended coverage sprinkler heads may be used with prior approval of architect, engineer, and
8 owner's representative.
9
10 C. Fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2" or 17/32" discharge
11 orifice except where greater than normal density requires large orifice.
12
13 D. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed
14 under normal conditions at installed location. Provide ordinary temperature (155 to 165 degree) fusible link or glass
15 bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment,
16 adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where
17 otherwise indicated.
18
19 E. Provide quantity of spare heads as noted below and 1 wrench for each type of head and each temperature range
20 installed. Provide 6 spare heads per 300 or less installed heads, 12 per 1000 or less and 24 for more than 1000. Provide
21 steel cabinet for storage of heads and wrenches. Provide an equal number of concealed cover plates and/or sprinkler
22 escutcheons for each spare sprinkler head.
23
24 F. Quick Response SSU Upright: Viking Microfast M (QR), brass finish.
25
26 G. Quick Response SSU Pendant: Viking Microfast M, brass finish.
27
28 H. Control Mode Density Area (CMDA) Pendant and Upright: Viking Extended Coverage, Minimum 8.0 K Factor, brass
29 finish
30 I.
31
32 J. Quick Response Sidewall: Viking Microfast M, chrome plated finish and escutcheon.
33
34
35 K. Concealed sprinkler: Viking Mirage (Quick Response), with adjustable concealed cover plate. Cover plate finish to be
36 selected by the Architect/Engineer from the manufacturer's standard finish selections.
37
38 L. Provide guards (Tyco model G1) where mechanical damage is likely and also where indicated on plans.
39

40 **2.5 FLEXIBLE SPRINKLER DROP FITTINGS**

- 41 A. Manufacturers: FlexHead Industries, Victaulic or Viking.
42
43 B. Corrugated Type 304 stainless steel hose with braided Type 304 stainless steel exterior cover, welded stainless steel
44 or zinc plated steel inlet and outlet threaded fittings with EPDM seals. 175 PSI pressure rating. 225 °F temperature
45 rating, 1" minimum internal hose diameter. 40" maximum hose length, straight or angle outlet configuration.
46 Galvanized steel ceiling support bar and brackets selected to match project ceiling support system requirements. UL
47 Listed and FM approved.
48
49 C. Flexible drops are only allowed for use above fully accessible ACT ceilings. Flexible drops shall not be utilized in hard
50 lid ceilings.
51

52 **2.6 FLOW SWITCHES**

- 53 A. Vane type waterflow switch with metal enclosure, adjustable pneumatic retard and electrical characteristics
54 compatible with alarm system.
55
56

1 **2.7 LOCAL ALARM**

- 2 A. Weatherproof electric horn/strobe with red painted metal housing, mounting base and weatherproof gasket seal,
3 and electrical characteristics compatible with alarm system. The horn strobe should be mounted above or as close
4 as possible to the fire department connection.

5
6 **2.8 PRESSURE GAUGES**

- 7 A. Manufacturer: Ametek/U. S. Gauge Division, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Weksler.
8
9 B. Cast aluminum, stainless steel, brass, polycarbonate or ABS case of not less than 3.5 inches in diameter, double
10 strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings,
11 recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the
12 remainder of the scale. Include bronze 3-way globe valve with plugged outlet for Fire Inspector's test gauge.

13
14 **2.9 VALVES**

- 15 A. Manufacturers: Kennedy, Milwaukee, Nibco, Stockham, Victaulic, or Watts.
16
17 B. BALL VALVES:
18 1. 2" and smaller: Bronze, 2-piece, threaded or sweat ends, standard port, blowout proof stem, chrome plated
19 ball, glass reinforced seats, UL approved @ 250 psi. Watts No. B-6000 UL.
20
21 C. GATE VALVES:
22 1. 2" and smaller: Outside screw and yoke gate valves, 175 psig, bronze body, bronze mounted, screwed bonnet,
23 rising stem, solid wedge, with normally open tamper switch with double wire leads.
24
25 2. 2-1/2" and larger: Outside screw and yoke gate valves, 175 psig, cast iron body, bronze mounted, bolted
26 bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads.
27
28 D. BUTTERFLY VALVES:
29 1. 2" and smaller: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally
30 open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem.
31
32 2. 2" and larger: Cast or ductile iron body butterfly valve, lug style or grooved, 175 psig, geared operator, visible
33 position indicator, normally open tamper switch with double wire leads, EPDM resilient seat, EPDM seals,
34 nickel plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe
35 attached. Use cap screws for removal of downstream piping while using the valve for system shutoff.
36
37 E. SUPERVISORY/TAMPER SWITCHES:
38 1. For O S & Y valve or butterfly valve installations, UL/FM listed/approved, to monitor position of valve, tamper
39 resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use,
40 NEMA 4 & 6P enclosures.
41
42 F. CHECK VALVES:
43 1. 3" and smaller: Bronze body, threaded end, Y-pattern, regrindable bronze seat, renewable bronze disc, 175
44 psig, suitable for installation in a horizontal or vertical line with flow upward.
45
46 2. 2-1/2" and larger: Cast or ductile iron body, flanged or grooved ends, bronze trim, bolted cap, renewable
47 bronze seat and disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.
48
49 3. Provide 1/2" automatic ball drip drain on inlet of fire dept. connection check valve. Pipe drain to grade or
50 floor drain.
51
52 G. SPRING LOADED CHECK VALVES:
53 1. 2" and smaller: Bronze body, threaded ends, bronze trim, stainless steel spring, stainless steel center guide
54 pin, 175 psig, teflon seat unless only bronze available.
55
56 2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless
57 steel spring, stainless steel stem if stem is required, 175 psig.
58

- 1 H. DRAIN VALVES:
2 1. 3/4" minimum, two piece bronze body ball valve; threaded ends, chrome plated bronze ball; glass filled teflon
3 seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG, with hose thread outlet
4 and cap.
5
6 I. DOUBLE CHECK DETECTOR ASSEMBLY:
7 1. Manufacturers: Ames, Conbraco, Febco, Watts, or Wilkins.
8
9 2. ASSE 1015 8" double check backflow preventer with 2 independent spring loaded swing type check valves, 2
10 isolation butterfly or gate valves with normally open tamper switch with double wire leads, 4 valved test
11 ports. Size for minimum pressure drop. Constructed of bronze or epoxy coated cast/ductile iron or stainless
12 steel body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze
13 seats, rated for 175 psig.
14
15 **2.10 SPECIALTY VALVES**
16 A. HOSE OUTLET VALVES
17 1. Manufacturer: Tyco, Reliable, Victaulic, Viking and Globe.
18
19 2. 2-1/2" brass angle valve, 300 psig, with removable red handwheel, 2-1/2"x1-1/2" reducing lug pin connector
20 coupling and National Standard male hose thread outlet, cap and chain. Provide N.P.T. female outlet where
21 hose is required.
22
23 **2.11 FIRE DEPARTMENT CONNECTION**
24 A. Manufacturer: Badger-Powhatan, Croker, Elkhart Brass, J.W. Moon, Potter-Roemer, and W.D. Allen Siamese
25 Connection:
26 1. Polished cast brass or ductile iron flush fire department inlet, two-way inlet body, swing clappers, pin-lug
27 swivels and caps with chains, 2-1/2" National Standard female hose thread inlets, 4"outlet, cast brass lettered
28 identification backplate.
29
30 **2.1 FIRE PUMP TEST CONNECTION**
31 A. Manufacturer: Badger-Powhatan, Croker, Elkhart Brass, J.W. Moon, Potter-Roemer, and W.D. Allen Siamese
32 Connection:
33 1. Polished cast brass or ductile iron flush fire department inlet, two-way inlet body, swing clappers, pin-lug
34 swivels and caps with chains, 2-1/2" National Standard female hose thread inlets, 4"outlet, cast brass lettered
35 identification backplate.

36 **PART 3 - EXECUTION**

- 37 **3.1 GENERAL**
38 A. Install pipe fittings, and other fire suppression system components in accordance with reference standards,
39 manufacturers recommendations and recognized industry practices.
40
41 **3.2 PREPARATION**
42 A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each
43 section of pipe and fitting prior to assembly.
44
45 **3.3 ERECTION**
46 A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window,
47 doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to
48 clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment
49 of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling
50 heights, ceiling grid layout, light fixtures and grilles before installing piping.
51 B. Where steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe
52 insulation.
53

- 1 C. Provide 3/32" min. thickness steel nailing plates behind or on either side of piping where the possibility of penetration
- 2 from nails or drywall screws exists.
- 3
- 4 D. Maintain piping in clean condition internally during construction.
- 5
- 6 E. Provide clearance for access to valves and piping specialties.
- 7
- 8 F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract
- 9 without damage to itself, equipment, or building.
- 10
- 11 G. Install piping so that system can be drained. Where possible, slope to main drain valve. Slope dry pipe and pre-action
- 12 systems subject to freezing at minimum 1/4"/10' on mains and 1/2"/10' on branches. Where piping not susceptible
- 13 to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose
- 14 thread outlet and cap for drainage over 5 gallons. Pipe main drain valve to grade.
- 15
- 16 H. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not
- 17 acceptable.
- 18
- 19 I. Do not route piping within exterior walls.
- 20
- 21 J. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the
- 22 required service space for this equipment, unless the piping is serving this equipment.
- 23
- 24 K. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide
- 25 access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed
- 26 by others where same requires the piping services indicated in this section.
- 27

3.4 PIPE JOINTS

- 28 A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where
- 29 applicable. "Weldolets" and "Threadolets" may be used up to following sizes:
- 30

31	Maximum	
32	Weldolet/	Main
33	Threadolet	Pipe
34	Diameter	Diameter
35	¾"	1¼"
36	1"	1½"
37	1¼"	2"
38	1½"	2½"
39	2"	3"
40	3"	4"
41	4"	6"
42	6"	8"
43		
44		

3.5 THREADED PIPE JOINTS

- 45 A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be
- 46 allowed.
- 47
- 48

3.6 MECHANICAL GROOVED PIPE CONNECTIONS

- 49 A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in
- 50 accordance with the same specifications using specially designed tools available for the application. Lubricate pipe
- 51 and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.
- 52
- 53

1 **3.7 UNIONS AND FLANGES**

- 2 A. Install a union, flange or grooved coupling combination at each connection to each piece of equipment and at other
3 items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of
4 equipment, locate the flange or union or grooved coupling combination connections on the equipment side of the
5 valve. Concealed unions, flanges or couplings are not acceptable.
6

7 **3.8 FLEXIBLE SPRINKLER DROP FITTINGS**

- 8 A. Install in acoustical ceilings only in accordance with manufacturer's installation instructions following minimum
9 bend radii, maximum number of bends and bend distance from end requirements.
10

11 **3.9 PIPING SYSTEM LEAK TESTS**

- 12 A. Conduct pressure test with test medium of water. If leaks are found, repair the area with new materials and repeat
13 the test; caulking will not be acceptable.
14
15 B. Test piping in sections or entire system as required by sequence of construction. Do not conceal pipe until it has been
16 successfully tested. If required for the additional pressure load under test, provide temporary restraints at fittings or
17 expansion joints. Entire test must be witnessed by the Division's representative.
18
19 C. Use clean water and remove air from the piping being tested where possible. Measure and record test pressure at
20 the high point in the system.
21
22 D. Test system at 200 psi for 2 hours showing no leakage. Where system design is in excess of 150 psig, test at a pressure
23 50 psig above system design pressure.
24
25 E. All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.
26

27 **3.10 UNDERGROUND WATER MAIN FLUSHING**

- 28 A. Conduct flushing of the underground water/fire main service as required by NFPA 13. The 200 PSI pressure test of
29 the main shall be conducted by the installer of the main. The flushing operation is to be documented on NFPA
30 Underground Contractor's Material and Test Certificate forms.
31

32 **3.11 INSTALLATION**

- 33 A. Install fire protection system components in accordance with NFPA rulings, listings and manufacturers
34 recommendations. Locate where accessible for servicing and replacement.
35
36 B. Sprinkler Heads: Locate sprinkler heads as indicated on fire protection plan and reflected ceiling plan maintaining
37 minimum clearances from obstructions, ceilings and walls. Install sprinkler heads level in locations not subject to
38 spray pattern interference. Provide fire sprinkler head installations below ductwork, soffits, etc.
39
40 C. Return Bends shall be installed on all wet pipe pendent style sprinkler heads regardless of water source.
41
42 D. Switches: Locate flow switches where indicated and where required to obtain specified zoning to isolate floors and
43 major areas of floors. Provide valved test connection for flow switch adjacent to flow switch. Pipe to floor drain. Test
44 flow switch to verify proper operation.
45
46 E. Gauges: Provide a valved pressure gauge in main fire protection riser, at the top of each piping riser, at inlet and
47 outlet of pump and elsewhere as indicated.
48
49 F. Valves: Properly align piping before installation of valves. Do not support weight of piping system on valve ends.
50 Mount valves in locations which allow access for operation, servicing and replacement. Install all valves with the stem
51 in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff
52 valve and a capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to
53 allow draining of each portion of piping.
54

1 G. Hose Outlet Valves: Install where indicated approximately 4' above floor. Fire Department Connections and Fire Pump
2 Test Connection: Mount on wall where indicated. Support from structure independent of piping. Locate between 2'
3 to 3' above grade. Fill wall penetration with insulation and caulk exterior and interior face of wall opening
4 weathertight. Provide FDC forward flow bypass to facilitate forward flow tests.
5
6

7 END OF SECTION 211000
8

SECTION 21 30 00
FIRE PUMPS

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for fire suppression system components and accessories.

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Shop Drawings
7. Certifications
8. Delivery, Storage and Handling
9. Design Criteria
10. Electrical Coordination

C. PART 2 - PRODUCTS

1. Single Stage Close Coupled Vertical In-Line Fire Pump
2. Horizontal Turbine Pressure Booster Jockey Pump
3. Fire Pump Controller
4. Jockey Pump Controller

D. PART 3 - EXECUTION

1. Installation
2. Construction Verification Items

1.2 RELATED WORK

- A. Section 01 91 01– Commissioning Process
- B. Section 21 05 00 – Common Work Results for Fire Suppression
- C. Section 21 05 29 – Hangers and Supports for Fire Suppression Piping and Equipment
- D. Section 21 10 00 – Water-Based Fire Suppression Systems
- E. Division 26 - Electrical.

1.3 REFERENCE

- A. Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASSE 1015 Double Check Valve Backflow Preventers.
- B. NFPA 13 Installation of sprinkler systems. (Latest prevailing edition)
- C. NFPA 20 Installation of centrifugal fire pumps. (Latest prevailing edition)
- D. NFPA 71 Installation, maintenance and use of signaling systems for central station service (Latest prevailing edition)
- E. NFPA 72 Installation, maintenance and use of protective signaling systems (Latest prevailing edition)

1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

1.6 SHOP DRAWINGS

- A. Submit fabrication drawings showing pipe sizes, fittings, devices and locations. Submit corresponding hydraulic calculations.
- B. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump curves, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1 **1.7 CERTIFICATIONS**

- 2 A. Fire protection system components to be UL listed and labeled. All components to be Factory Mutual approved with
3 the exception of sprinkler heads, double check valves and air compressors. All system components shall be in
4 conformance with NFPA rulings.

5
6 **1.8 DELIVERY, STORAGE, AND HANDLING**

- 7 A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
8

9 **1.9 DESIGN CRITERIA**

- 10 A. Fire protection system components to be rated for minimum operating pressure of 175 psig.
11
12 B. Component design, construction and installation to comply with requirements of reference standards.
13

14 **1.10 ELECTRICAL COORDINATION**

- 15 A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the power side of the control of fire
16 protection motors or electrical equipment shall be furnished by the Electrical Contractor, except as specifically noted
17 elsewhere in this division of specifications.
18
19 B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this
20 Contractor. Should any change in size, horsepower rating or means of control be made to any motor or other
21 electrical equipment after contracts are awarded, Contractor is to immediately notify the Electrical Contractor of this
22 change and pay any costs due to this change.
23
24 C. Electrical Contractor shall provide all power wiring and the Fire Protection Contractor shall provide all control wiring.
25 Control wiring shall conform to Division 16 requirements for Control Wiring.
26
27 D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and
28 indicated to be wired by the Electrical Contractor.
29

30 **1.11 ELECTRICAL COORDINATION**

- 31 A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical
32 equipment are furnished by the Electrical Contractor, except as specifically noted elsewhere in this division of
33 specifications.
34
35 B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this
36 Contractor. Should any change in size, horsepower rating or means of control be made to any motor or other
37 electrical equipment after contracts are awarded, Contractor is to immediately notify the Electrical Contractor of this
38 change and pay any costs due to this change.
39
40 C. Electrical Contractor will provide all power wiring and the Fire Protection Contractor shall provide all control wiring.
41 Control wiring shall conform to Division 28 requirements for Control Wiring.
42
43 D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and
44 indicated to be wired by the Electrical Contractor.
45

46 **PART 2 - PRODUCTS**

47
48 **2.1 SINGLE STAGE CLOSE COUPLED VERTICAL IN-LINE FIRE PUMP**

- 49 A. Manufacturer: Fairbanks Morse, Grundfos, ITT A-C, or engineer approved equal.
50
51 B. The pump will provide the scheduled capacity. At 150% of rated capacity, the pump shall develop at least 65% of its
52 rated head and shall not exceed 140% of the rated head at zero capacity. The pump shall be tested at the factory
53 and a test curve shall be submitted showing the performance and horsepower requirements based on this test before
54 final acceptance.
55
56 C. The pump shall be a single stage, close coupled, vertical in-line design, in cast iron bronze fitted construction with
57 packing bearing directly on a stainless steel or a bronze shaft sleeve. The pump internals shall be capable of being
58 serviced without disturbing piping connections.

- 1
2 D. Support pump per manufacturer's recommendations.
3
4 E. The pump casing shall be made of cast iron ASTM #A278, Class 30 or 35, or ductile iron ASTM #A536, Grade 65, with
5 the suction and discharge flanges located on a common centerline, 180° apart, for mounting in the pipeline. The
6 standard pipe flanges shall be drilled for 125# per ANSI B16.1 standard.
7
8 F. The pump shall be rated for a minimum of 175 psi working pressure and a maximum of 370 psi with 250# discharge
9 flanges and ductile iron casing.
10
11 G. The impeller will be cast bronze ASTM #B584 – Alloy 875, enclosed type, balanced, keyed to the shaft and secured
12 by a cap screw and lockwasher.
13
14 H. The casing wear rings shall be made of bronze and can be easily replaced.
15
16 I. The pump shall be direct coupled to the motor shaft for easy maintenance, to minimize impeller run out and to
17 reduce noise.
18
19 J. The pump shall have a vertical back pullout design that makes servicing simple and fast. The rotating element is easily
20 removed without disturbing the piping.
21
22 K. The pump shall have split bronze packing glands for easy packing replacement.
23
24 L. The stuffing box shall be furnished with impregnated yarn packing, lantern ring and a catch basin for piping leakage
25 to drain.
26
27 M. The pump shall have gauge tapings at the suction and discharge nozzles and vent and drain tapings at the top and
28 bottom.
29
30 N. A rubber slinger will be installed on the shaft before the motor to prevent the passage of liquid to the motor.
31
32 O. Nameplates and other data plates shall be all corrosion resistant and suitably secured to the pump.
33
34 P. Accessories
35 1. 3 ½" dial suction and discharge gauges
36
37 2. ¾" casing relief valve
38
39 3. Eccentric suction reducer (if required)
40
41 4. Concentric discharge increaser (if required)
42
43 5. Main relief valve
44
45 6. Closed waste cone
46
47 7. Suction control valve
48
49 **2.2 HORIZONTAL TURBINE PRESSURE BOOSTER JOCKEY PUMP**
50 A. Manufacturer: Aurora, Pacific (Paco), Roth, or approved equal.
51
52 B. Type: Horizontal direct coupled shaft, basemount design, 300 psig maximum working pressure.
53
54 C. Casing: Cast iron with threaded suction and discharge connections.
55
56 D. Impeller: Bronze turbine with bronze bushing, keyed and locked to the shaft, hydraulically and dynamically balanced.
57
58 E. Shaft: Stainless steel with bronze or stainless steel shaft sleeve.

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- F. Seal: Mechanical type shaft seal with carbon steel rings and ceramic seats.
- G. Provide pump with a motor sized for non-overloading over the entire pump curve. Motors to be 1750 rpm unless specified otherwise.
- H. Accessories: Suction and discharge gauges and gauge cocks and relief valve.
- I. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current. The manufacturer shall certify all pump ratings.

2.3 FIRE PUMP CONTROLLER

- A. Manufacturer: ITT, Joslyn/Clark, Master Control Systems
- B. General: Select fire pump controller with electrical characteristics matching pump motor. Factory fabricate and test fire pump controller assembly. Identify assembly with "Fire Pump Controller" label on control panel face. Permanently attach wiring diagrams to inside of cabinet. Provide cabinet and door mounted nameplates identifying each device or switch mounted within cabinet and on door, panel manufacturer and model number.
- C. Enclosure: Floor mounted formed and welded steel, NEMA 12, with hinged and latched door, phosphatized and baked enamel finish.
- D. Motor Starter: Class A, NEMA ICS 2, across-the-line magnetic soft starting, non-reversing type. Capable of automatic start initiated by low water pressure switch, remote starting by a normally closed contact and manual starting by front panel mounted control.
- E. Overcurrent Protection: Circuit breakers with test switch and self-contained electronic trip circuit designed and listed for fire pump locked rotor application. Connect directly to HOA switch load side.
- F. Controls: Front panel mounted hand-off-auto switch, 300 psi brass mercoid water pressure switch with low turn on and high turn off adjustable settings and exterior brass bulkhead connection, minimum run timer with manual stop switch, restart time delay. Provide phase reversal relay.
- G. Alarms: Local audible and visual alarm indication as well as remote contacts for loss of power, and phase reversal along with alarm silence switch. Remote contact for fire pump operation (motor current greater than 20% FLA).
- H. Wiring: Terminations for exterior power and control connections, space in cabinet for terminating incoming and outgoing cables at entry, identification of power and control wiring at terminals and ground bar.
- I. When an emergency generator is installed on the project, call for an automatic transfer switch installation to be provided within the fire pump controller panel.

2.4 JOCKEY PUMP CONTROLLER

- A. Manufacturer: ITT, Joslyn/Clark, Master Control Systems.
- B. General: Select booster pump controller with electrical characteristics matching pump motor. Permanently attach wiring diagrams to inside of cabinet.
- C. Enclosure: Wall mounted formed and welded steel, NEMA 2, gasketed with driphood, hinged and latched door, phosphatized and baked enamel finish.
- D. Motor Starter: Class A, NEMA ICS 2, across-the-line magnetic full voltage starting, non-reversing type with overload relays. Capable of automatic start initiated by low water pressure switch and manual starting by front panel mounted control.
- E. Overcurrent Protection: Fusible disconnect switch with panel face mounted handle.

- 1 F. Controls: Front panel mounted hand-off-auto switch, 300 psi brass mercoid water pressure switch with low turn on
2 and high turn off adjustable settings and exterior brass bulkhead connection, minimum run timer.
3
4 G. Alarms: Contacts for remote indication of pressure booster pump running (motor current greater than 20% FLA).
5
6 H. Wiring: Terminations for exterior power and control connections, space in cabinet for terminating incoming and
7 outgoing cables at entry, identification of power and control wiring at terminals.
8

9 **PART 3 - EXECUTION**

10
11 **3.1 INSTALLATION**

- 12 A. Install fire protection system components in accordance with NFPA rulings, listings and manufacturers
13 recommendations. Locate where accessible for servicing and replacement.
14
15 B. Pumps: Set base mounted pumps on concrete bases, or concrete inertia base, level and bolt down prior to grouting.
16 Fill the entire base with non-shrinking grout when required by the manufacturer's installation instructions.
17
18 C. Align all flexible coupled base-mounted pumps in accordance with the manufacturer's instructions.
19
20 D. Decrease from line size at pump connections with eccentric suction reducer offset with the top of the pipe level. All
21 pump valves and piping specialties must be full line size. Support piping adjacent to pump such that no weight is
22 carried on pump casings. For base mounted pumps, provide supports for elbows on pump suction and discharge
23 piping 4" and over.
24
25 E. Provide automatic air vent, drain valve, relief valve and pressure gauges on pump casings
26 F.
27 G. Provide drains for bases and seals, piped to and discharging into floor drains.
28
29 H. Provide 1/2" Type L copper pressure sensor line from between pump discharge check valve and shutoff valve to
30 pump controller pressure switch. Provide bronze swing check valve with 3/32" orifice in clapper along with two test
31 valves and intermediate tee with 1/4" test plug at pump and at controller for testing and relieving pressure (NFPA
32 20, A-7-5.2.1). Each pump, including pressure booster pump, to have its own dedicated sensor line.
33
34 I. Lubricate pumps before startup.
35
36 J. Fire Pump Controller: Install on concrete housekeeping pad, leveled and bolted in place. Pipe pressure sensor line
37 to controller. Coordinate wiring with electrical contractor. Startup, test and adjust for proper operation of alarms
38 and operating controls. Adjust pressure switches in accordance with NFPA 20, A-11-4.
39
40 K. Pressure Booster Pump Controller: Mount securely on wall. Pipe pressure sensor line to controller. Coordinate wiring
41 with electrical contractor. Startup, test and adjust for proper operation of alarms and operating controls. Adjust
42 pressure switches in accordance with NFPA, A-11-4.
43

44 **3.2 CONSTRUCTION VERIFICATION ITEMS**

- 45 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 21
46 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.
47
48

END OF SECTION

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**SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING**

PART 1 GENERAL

1.1 SCOPE

A. This section includes information common to two or more technical plumbing specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Lead Free Requirements
6. Quality Assurance
7. Continuity of Existing Services
8. Protection of Finished Surfaces
9. Sleeves and Openings
10. Sealing and Fire Stopping
11. Equipment Furnished By Others
12. Provisions for Future
13. Submittals
14. Off Site Storage
15. Codes
16. Certificates and Inspections
17. Operating and Maintenance Data
18. Record Drawings

C. PART 2 - PRODUCTS

1. Access Panels and Doors
2. Identification
3. Sealing and Fire Stopping
4. Bedding and Backfill

D. PART 3 - EXECUTION

1. Demolition
2. Excavation and Backfill
3. Sheeting, Shoring and Bracing
4. Dewatering
5. Rock Excavation
6. Surface Repair
7. Concrete Work
8. Cutting and Patching
9. Building Access
10. Equipment Access
11. Coordination
12. Identification
13. Lubrication
14. Sleeves and Openings
15. Sealing and Fire Stopping
16. Agency Training

1.2 RELATED WORK

- A. Section 01 91 01 – Commissioning Process
- B. Section 07 84 00 – Fire Stopping

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.
- B. This section applies to all Division 22 00 00 sections of plumbing.
- C. City Madison

1 **1.4 REFERENCE STANDARDS**

2 A. Abbreviations of standards organizations referenced in this and other sections are as follows:

- 3 1. ABMA American Boiler Manufacturers Association
- 4 2. ACPA American Concrete Pipe Association
- 5 3. AGA American Gas Association
- 6 4. AMCA Air Movement and Control Association
- 7 5. ANSI American National Standards Institute
- 8 6. ARI Air Conditioning and Refrigeration Institute
- 9 7. ASME American Society of Mechanical Engineers
- 10 8. ASPE American society of Plumbing Engineers
- 11 9. ASSE American Society of Sanitary Engineering
- 12 10. ASTM American Society for Testing and Materials
- 13 11. AWWA American Water Works Association
- 14 12. AWS American Welding Society
- 15 13. CISPI Cast Iron Soil Pipe Institute
- 16 14. CGA Compressed Gas Association
- 17 15. CS Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS
- 18 16. DSPS State of Wisconsin Dept. of Safety and Professional Services, State Plumbing Code
- 19 17. EPA Environmental Protection Agency
- 20 18. FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
- 21 19. GAMA Gas Appliance Manufacturers Association
- 22 20. IAPMO International Association of Plumbing & Mechanical Officials
- 23 21. IEEE Institute of Electrical and Electronics Engineers
- 24 22. ISA Instrument Society of America
- 25 23. MCA Mechanical Contractors Association
- 26 24. MICA Midwest Insulation Contractors Association
- 27 25. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
- 28 26. NBS National Bureau of Standards
- 29 27. NEC National Electric Code
- 30 28. NEMA National Electrical Manufacturers Association
- 31 29. NFPA National Fire Protection Association
- 32 30. NSF National Sanitation Foundation
- 33 31. PDI Plumbing and Drainage Institute
- 34 32. SMACNA Sheet Metal and Air Conditioning Contractors' National Association. Inc.
- 35 33. STI Steel Tank Institute
- 36 34. UL Underwriters Laboratories Inc.

37 **1.5 STANDARDS REFERENCED IN THIS SECTION:**

- 38 A. ACI 614 Recommended Practice for Measuring, Mixing and Placing of Concrete
- 39 B. ASTM D1557 Standard Test Method for Moisture-Density Relations of Soils
- 40 C. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
- 41 D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
- 42 E. UL1479 Fire Tests of Through-Penetration Firestops
- 43 F. UL723 Surface Burning Characteristics of Building Materials

44 **1.6 LEAD FREE REQUIREMENTS**

- 45 A. All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings
46 and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per the Federal Safe
47 Drinking Water Act as amended January 4th 2011 Section 1417.
- 48 B. This requirement applies to all the subsequent Plumbing Specification Sections and Plumbing Drawings and
49 supersedes any part or model number that may conflict with this requirement.

50 **1.7 QUALITY ASSURANCE**

- 51 A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- 52 B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and
53 materials are not to be reused unless specifically indicated.
- 54 C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or
55 engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs

1 involved in integrating the equipment or accessories into the system and for obtaining the intended performance
2 from the system into which these items are placed.

3 **1.8 CONTINUITY OF EXISTING SERVICES**

4 A. Do not interrupt or change existing services without prior written approval from the Owner's Project Representative.
5 When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his
6 activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done
7 during normal working hours.

8 **1.9 PROTECTION OF FINISHED SURFACES**

9 A. Refer to Division 1, General Requirements, Protection of Finished Surfaces.

10 **1.10 SLEEVES AND OPENINGS**

11 A. Refer to Division 1, General Requirements, Sleeves and Openings.

12 **1.11 SEALING AND FIRE STOPPING**

13 A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the
14 responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire
15 individuals skilled in such work to do the sealing and fireproofing. Provide all fire stopping of fire rated penetrations
16 and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

17 **1.12 EQUIPMENT FURNISHED BY OTHERS**

18 A. Bus Wash Equipment
19 B. Reclaim water modular assembly.

20 **1.13 PROVISIONS FOR FUTURE**

21 A. Bus Wash Equipment
22 B. Chassis wash equipment

23 **1.14 OFF SITE STORAGE**

24 A. Prior approval by City of Madison Project Representative and the A/E will be needed. The contractor shall submit
25 Storage Agreement to City of Madison Project Representative for consideration of off site materials storage.
26 Generally, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for off site storage. No
27 material will be accepted for off site storage unless shop drawings for the material have been approved.

28 **1.15 CODES**

29 A. Comply with requirements of Wisconsin Administrative Code.

30 **1.16 CERTIFICATES AND INSPECTIONS**

31 A. Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.
32 B. Obtain and pay for all required State and City of Madison installation inspections except those provided by the
33 Architect/Engineer. Deliver the originals of inspection certificates and test records to the Owner's Project
34 Representative. Include copies of the certificates and test records in the Operating and Maintenance Instructions.

35 **1.17 SUBMITTALS**

36 A. Refer to Division 1, General Conditions, Submittals.
37 B. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list
38 page showing item designation, manufacturer and additional items supplied with the installation. Submit for all
39 equipment and systems as indicated in the respective specification sections, marking each submittal with that
40 specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted
41 and proper identification of equipment by name and/or number, as indicated in the contract documents. Include
42 wiring diagrams of electrically powered equipment.
43 C. The specific items that will be required for submittals shall be coordinated with the City of Madison Project
44 Representative, the A/E, and the General Prime Contractor for inclusion in the project submittal log.
45 D. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:
46 1. Operating and Maintenance Manuals 2 copies
47 2. Division of Facilities Development 1 copy
48 3. Architect/Engineer 1 copy

1 **1.18 OPERATION AND MAINTENANCE DATA**

- 2 A. All operations and maintenance data shall comply with the submission and content requirements specified under
3 section GENERAL REQUIREMENTS.
4 B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
5 documentation:
6 1. Records of tests performed a to certify compliance with system requirements
7 2. Manufacturer's wiring diagrams for electrically powered equipment
8 3. Certificates of inspection by regulatory agencies
9 4. Valve schedules
10 5. Lubrication instructions, including list/frequency of lubrication
11 6. Parts lists for fixtures, equipment, valves and specialties.
12 7. Manufacturers installation, operation and maintenance recommendations for fixtures, equipment, valves and
13 specialties.
14 8. Additional information as indicated in the technical specification sections

15 **1.19 TRAINING OF OWNER PERSONNEL**

- 16 A. Instruct user agency personnel in the proper operation and maintenance of systems and equipment provided as part
17 of this project. Include not less than 4 hours of instruction, using the Operating and Maintenance manuals during
18 this instruction. Demonstrate startup, operation and shutdown procedures for all equipment. All training to be
19 during normal working hours. Video record all instructions and provide Owner with copy.

20 **1.20 RECORD DRAWINGS**

- 21 A. Refer to Division 1, General Requirements, Record Drawings.

22 **PART 2 - PRODUCTS**

23 **2.1 ACCESS PANELS AND DOORS**

- 24 A. LAY-IN CEILINGS:
25 1. Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Section 09500 are
26 sufficient; no additional access provisions are required unless specifically indicated.
27 B. MASONRY WALLS, GYPSUM BOARD AND PLASTER WALLS AND CEILINGS:
28 1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications,
29 stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam
30 latch for general applications, key lock for use in public or secured areas, UL listed for use in fire rated partitions
31 if required by the application. Use the largest size access opening possible, consistent with the space and the
32 item needing service; minimum size is 12" by 12".

33 **2.2 IDENTIFICATION**

- 34 A. STENCILS:
35 1. Not less than 1 inch high letters/numbers for marking pipe and equipment.
36 B. ENGRAVED NAME PLATES:
37 1. White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply
38 Style 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.
39 C. ADHESIVE LABELS:
40 1. Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, 3/4" min. size for lettering and
41 surrounding tape on both ends. With flow arrows on piping. Conforming to ANSI, ANSI and NFPA standards.
42 Seton Opti-Code, MSI, Brady or approved equal. Clean piping before application.
43 D. SNAP-AROUND PIPE MARKERS:
44 1. One-piece, preformed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling
45 and flow direction arrows, 3/4" min. size for lettering. Provide nylon ties on each end of pipe markers. Equal to
46 Seton Setmark.
47 E. VALVE TAGS:
48 1. Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum
49 diameter, with brass jack chains, brass "S" hooks around the valve stem, available from EMED Co., Seton Name
50 Plate Company, or W. H. Brady.
51
52

1 **2.3 BEDDING AND BACKFILL**

- 2 A. Bedding up to a point 12" inches above the top of the pipe shall be thoroughly compacted sand or crushed stone
3 chips meeting the following gradations:

4

<u>Gradation for Bedding Sand</u>		<u>Gradation for Crushed Stone Chip Bedding</u>	
<u>Sieve Size</u>	<u>% Passing (by Wt)</u>	<u>Sieve Size</u>	<u>% Passing (by Wt)</u>
1 inch	100	1/2 inch	100
No. 16	45 - 80	No. 4	75 - 100
No. 200	2 - 10	No. 100	10 - 25

11

- 12 B. Backfill above the bedding under existing and future utilities and buildings shall be granular materials, pit run sand,
13 gravel, or crushed stone, free from large stones, organic, perishable, and frozen materials.

14 **2.4 SEALING AND FIRE STOPPING**

- 15 A. FIRE AND/OR SMOKE RATED PENETRATIONS:

16 1. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with
17 section 07 84 00 "Fire Stopping".

- 18 B. NON-RATED PENETRATIONS:

19 1. At pipe penetrations of non-rated interior partitions, floors and exterior walls, use urethane caulk in annular
20 space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not
21 required use urethane caulk in annular space between pipe insulation and wall material

22 **PART 3 - EXECUTION**

23
24 **3.1 DEMOLITION**

- 25 A. Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be
26 performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to
27 minimize the amount of contamination of the occupied space. Where pipe is removed and not reconnected with
28 new work, cap ends of existing services as if they were new work. Coordinate work with the Owner to minimize
29 disruption to the existing building occupants.
- 30 B. All pipe, fixtures, equipment, wiring and associated conduit, insulation and similar items demolished, abandoned, or
31 deactivated are to be removed from the site by the Contractor except as specifically noted otherwise. All designated
32 equipment is to be turned over to the user agency for their use at a place and time so designated. Maintain the
33 condition of material and/or equipment that is indicated to be reused equal to that existing before work began.

34 **3.2 EXCAVATION AND BACKFILL**

- 35 A. Perform all excavation and backfill work necessary to accomplish indicated plumbing systems installation. Excavate
36 to bottom of pipe and structure bedding, 4" in stable soils, 6" in rock or wet trenches and 8" in unstable soil. Finish
37 bottoms of excavations to true, level surface.
- 38 B. TRemove concrete to neat and straight lines to the limits of removal. Make sawcut lines parallel to existing joints, or
39 parallel or perpendicular to building walls to form a neat patch. Carefully remove remaining concrete within the
40 sawcut area. Leave existing base materials between the area disturbed by the work and the sawcut line undisturbed
41 by the sawcutting, concrete removal, or concrete replacement processes.
- 42 C. At no time place excavated materials where they will impede surface drainage unless such drainage is being safely
43 rerouted away from the excavation.
- 44 D. Excavate whatever materials are encountered as required to place at the elevations shown, all pipe, and other work.
45 Remove debris and rubbish from excavations before placing bedding and backfill material.
- 46 E. Remove surplus excavated materials from site.
- 47 F. Verify the locations of any water, drainage, gas, sewer, electric, or telephone which may be encountered in the
48 excavation. Underpin and support all lines. Cut off service connections encountered which are to be removed at the
49 limits of the excavation and cap.
- 50 G. Provide and maintain all fencing, barricades, signs, warning lights, and/or other equipment necessary to keep all
51 excavation pits and trenches and the entire subgrade area safe under all circumstances and at all times. No
52 excavation shall be left unattended without adequate protection.

- 1 H. Elevations shown on the plans are subject to such revisions as may be necessary to fit field conditions. No
2 adjustment in compensation will be made for adjustments up to two (2) feet above or below the grades indicated on
3 the plans.
4 I. Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and insure there is no
5 disturbance of bearing soil.
6 J. Bed pipe up to a point 12" above the top of the pipe. Take care during bedding, compaction and backfill not to
7 disturb or damage piping.
8 K. Mechanically compact bedding and backfill to prevent settlement. The initial compacted lift to not exceed 24"
9 compacted to 95% density per Modified Proctor Test (ASTM D-1557). Subsequent lifts under structures are not to
10 exceed 12" and be compacted to 95% density per Modified Proctor Test. In all other areas where construction above
11 the excavation is not anticipated within 2 years, mechanically compact backfill in lifts not exceeding 24" to 90%
12 density per Modified Proctor Test. Route the equipment over each lift of the material so that the compaction
13 equipment contacts all areas of the surface of the lift.

14 **3.3 SHEETING, SHORING AND BRACING**

- 15 A. Provide shoring, sheet piling and bracing in conformance with the Wisconsin Administrative Code to prevent earth
16 from caving or washing into the excavation. Shore and underpin to properly support adjacent or adjoining
17 structures. Abandon in place shoring, sheet piling and underpinning below the top of the pipe, or, if approved in
18 advance by the engineer, maintained in place until other permanent support approved by the engineer is provided.

19 **3.4 DEWATERING**

- 20 A. Provide, operate and maintain all pumps and other equipment necessary to drain and keep all excavation pits,
21 trenches and the entire subgrade area free from water under all circumstances. Obtain general permit from the
22 Wisconsin Department of Natural Resources district office for discharge of construction dewatering effluent. Obtain
23 well permit from the Wisconsin Department of Natural Resources district office for dewatering wells discharging
24 more than 70 GPM. Comply with permit requirements.

25 **3.5 ROCK EXCAVATION**

- 26 A. Remove rock encountered in the excavation to a minimum dimension of six (6) inches outside the pipe. Rock
27 excavation includes all hard, solid rock in ledges, bedded deposits and unstratified masses, all natural conglomerate
28 deposits so firmly cemented as to present all the characteristics of solid rock; which material is so hard or so firmly
29 cemented that in the opinion of the Engineer it is not practical to excavate and remove same with a power shovel
30 except after thorough and continuous drilling and blasting. Rock excavation includes rock boulders of 1/2 cubic yard
31 or more in volume.
32 B. Rock excavation will be computed on the basis of the depth of rock removed and a trench width two (2) feet larger
33 than the outside diameter of the pipe where one (1) pipe is laid in the trench and three (3) feet larger than the
34 combined outside diameter where two (2) pipes are laid in the trench. Include 6" pipe and structure bedding in rock
35 excavation. Include rock excavation shown on the plans in the Base Bid.

36 **3.6 SURFACE RESTORATION**

- 37 A. Completely restore the surface of all disturbed areas to a like condition of the surface prior to the work. Level off all
38 waste disposal areas and clean up all areas used for the storage of materials or the temporary deposit of excavated
39 earth. Remove all surplus material, tools and equipment.
40 B. Lawns: Topsoil with 4" of clean, friable, fertile topsoil conforming to D.O.T. Section 625, free from debris, lumps,
41 rocks, roots, plants and seeds. Grade surfaces to match adjacent elevations. Rake smooth, free of lumps and debris.
42 Sod with good quality nursery sod conforming to D.O.T. Section 631, be uniform, dense, free from weeds and consist
43 of approximately 60% Kentucky blue grass and the balance perennial rye, fescue and white clover. Place sod with
44 joints staggered and abutting. Maintain lawn areas for one month after installation. Contractor will be responsible
45 for necessary watering and mowing. Do necessary weeding, repair, reseeding or resodding until uniform catch is
46 obtained.

47 **3.7 CONCRETE WORK**

- 48 A. Cast-in-place concrete within the building will be performed by the Division 3 Contractor unless otherwise noted.
49 Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used
50 to form concrete for support or installation of plumbing piping, fixtures, specialties and equipment. Coordinate
51 locations of equipment, pipe penetrations in wet areas, etc. with the Division 3 Contractor.

- 1 **3.8 CUTTING AND PATCHING**
- 2 A. Refer to Division 1, General Requirements, Cutting and Patching.
- 3 **3.9 BUILDING ACCESS**
- 4 A. Arrange for the necessary openings in the building to allow for admittance or removal of all apparatus. When the
- 5 building access was not previously arranged and must be provided by this contractor, restore any opening to its
- 6 original condition after the apparatus has been brought into the building.
- 7 **3.10 EQUIPMENT ACCESS**
- 8 A. Install all piping, conduit and accessories to permit access to equipment for maintenance and service. Coordinate
- 9 the exact location of wall and ceiling access panels and doors with the General Prime Contractor, making sure that
- 10 access is available for all equipment and specialties. Access doors in general construction are to be furnished by the
- 11 Plumbing Contractor and installed by the General Prime Contractor.
- 12 B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not
- 13 require access panels.
- 14 **3.11 COORDINATION**
- 15 A. Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that interferes
- 16 with other contractor's work shall be removed or relocated at the installing contractor's expense.
- 17 B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.
- 18 **3.12 IDENTIFICATION**
- 19 A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of
- 20 black enamel against a light background or white enamel against a dark background. Use a primer where necessary
- 21 for proper paint adhesion.
- 22 B. Where stenciling is not appropriate for equipment identification, engraved name plates may be used.
- 23 C. Identify interior piping not less than once every 30 feet, not less than once in each room, adjacent to each access
- 24 door or panel, and on both side of the partition where accessible piping passes through walls or floors. Place flow
- 25 directional arrows at each pipe identification location. Use one coat of black enamel against a light background or
- 26 white enamel against a dark background.
- 27 D. Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags are not
- 28 required at a terminal device unless the valves are greater than ten feet from the device, located in another room or
- 29 not visible from device. Provide a typewritten valve schedule and pipe identification schedule indicating the valve
- 30 number and the equipment or areas supplied by each valve and the symbols used for pipe identification; locate
- 31 schedules in mechanical room and in each Operating and Maintenance manual. Schedule in mechanical room to be
- 32 framed under clear plastic.
- 33 **3.13 LUBRICATION**
- 34 A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for
- 35 any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's
- 36 instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of
- 37 lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.
- 38 **3.14 SLEEVES AND OPENINGS**
- 39 A. Pipe penetrations in new poured concrete horizontal construction requiring F and T rating: Form opening using hole
- 40 form or core drill opening. Alternatively provide cast in place fire stopping devices/sleeves.
- 41 B. Pipe penetrations in new poured concrete horizontal construction requiring F rating but no T rating: Same as pipe
- 42 penetrations in new poured concrete construction requiring F and T ratings except that schedule 40 steel sleeves
- 43 may also be used.
- 44 C. Pipe penetrations in new poured concrete horizontal construction that do not require F or T ratings: Provide
- 45 schedule 40 steel pipe sleeve, form opening using hole form or core drill opening.
- 46 D. Pipe penetrations in existing concrete floors: Core drill openings.
- 47 E. Where penetrating pipe or conduit weight is supported by floor, provide manufactured product or structural bearing
- 48 collar designed to carry load.
- 49
- 50

1 **3.15 SEALING AND FIRE STOPPING**

2 A. FIRE AND/OR SMOKE RATED PENETRATIONS:

- 3 1. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with
4 section 07 84 00 Fire Stopping.

5 B. NON-RATED PARTITIONS:

- 6 1. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both
7 sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and
8 the pipe or insulation is completely blocked.

9 C. PENETRATIONS SUBJECT TO WATER INTRUSION:

- 10 1. For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical
11 equipment (but not within walls) provide one of the following:

- 12 a. Pipe penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
13 b. Pipe penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above
14 the floor (provided it meets the device's UL listing).
15 c. Pipe penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2"x
16 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations
17 to prevent water from getting to penetration. Provide urethane caulk between angles and floor and
18 fasten angles to floor minimum 8" on center. Seal corners water tight with urethane caulk.

- 19 2. Floors subject to water intrusion or rooms housing electrical equipment include the following locations:

- 20 a. Restrooms
21 b. Locker/Shower Rooms
22 c. Janitor Rooms w/ Sinks
23 d. Mechanical/Plumbing Equipment Rooms
24 e. Chemical/Hazardous Waste Storage
25 f. Maintenance/Industrial Shops
26 g. Vehicle Storage and Parking Ramps
27 h. Data/Telecommunications Rooms
28 i. Electrical Equipment Rooms

- 29 3. Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the
30 fire stopping system from water) in areas subject to wash down.

31 **3.16 AGENCY TRAINING**

- 32 A. All training provided for agency shall comply with the format, general content requirements and submission
33 guidelines specified under Section 01 91 01.

- 34 B. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations,
35 maintenance and troubleshooting of the system and/or components defined within this section for a minimum
36 period of 4 hours.

37 **END OF SECTION**
38

1 SECTION 22 05 13
2 COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

3 **PART 1 - GENERAL**

4 **1.1 SCOPE**

- 5 A. This sections includes requirements for single and three phase motors that are used with equipment specified in
6 other sections. Included are the following topics:
- 7 B. PART 1 - GENERAL
- 8 1. Scope
- 9 2. Related Work
- 10 3. Reference
- 11 4. Reference Standards
- 12 5. Shop Drawings
- 13 6. Operating and Maintenance Data
- 14 7. Electrical Coordination
- 15 8. Product Criteria
- 16 C. PART 2 - PRODUCTS
- 17 1. Three Phase, Single Speed Motors
- 18 2. Single Phase, Single Speed Motors
- 19 D. PART 3 - EXECUTION
- 20 1. Installation

21 **1.2 RELATED WORK**

- 22 A. Section 01 91 01 – Commissioning Process
- 23 B. Section 22 42 00 - Commercial Plumbing Fixtures.
- 24 C. Section 22 30 00 - Plumbing Equipment for equipment requiring motors.
- 25 D. Division 26 00 00 - Electrical - Electrical for power wiring, starters, and other electrical devices

26 **1.3 REFERENCE**

- 27 A. Applicable provisions of Division 1 govern work under this section.

28 **1.4 REFERENCE STANDARDS**

- 29 A. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
- 30 B. ANSI/NEMA MG-1 Motors and Generators
- 31 C. ANSI/NFPA 70 National Electrical Code

32 **1.5 SHOP DRAWINGS**

- 33 A. Include with the equipment which the motor drives the following motor information: motor manufacturer,
34 voltage, phase, hertz, rpm, full load efficiency, full load power factor, service factor, NEMA design designation,
35 insulation class, and frame type.

36 **1.6 OPERATION AND MAINTENANCE DATA**

- 37 A. All operations and maintenance data shall comply with the submission and content requirements specified
38 under section GENERAL REQUIREMENTS.

39 **1.7 ELECTRICAL COORDINATION**

- 40 A. All starters, disconnects, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the
41 control of motors or electrical equipment are provided by the Electrical Contractor, except as specifically noted
42 elsewhere in this division of specifications.

- 1 B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this
 2 Contractor, together with their actuating devices if these devices are furnished by the Electrical Contractor.
 3 Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be made to any
 4 motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the
 5 architect/engineer of such discrepancy. Costs involved in any changes required due to equipment substitutions
 6 initiated by this contractor will be the responsibility of this contractor.
 7 C. The A/E must coordinate specified voltages with the Electrical Consultant for the project. The Electrical
 8 Contractor will provide all power wiring and the Plumbing Contractor will provide all control wiring. Control
 9 wiring shall conform to Division 16 requirements for Control Wiring.
 10 D. Furnish project specific wiring diagrams to Electrical Contractor for all equipment and devices furnished by this
 11 Contractor and indicated to be wired by the Electrical Contractor.

12 **1.8 PRODUCT CRITERIA**

- 13 A. Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by
 14 U.L. for the service specified.
 15 B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof,
 16 explosion proof, standard duty, high torque or any other special type as required by the equipment or motor
 17 manufacturer's recommendations.
 18 C. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

19 **PART 2 - PRODUCTS**

20 **2.1 THREE PHASE, SINGLE SPEED MOTORS**

- 21 A. Use NEMA rated three phase, 60 hertz motors for all motors 1/2 HP and larger unless specifically indicated.
 22 B. Use NEMA general purpose, continuous duty, Design B , normal starting torque, T-frame or U-frame motors with
 23 Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has
 24 different requirements. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-
 25 ventilated, explosion-proof, or encapsulated motors are specified in the equipment sections.
 26 C. Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for re-
 27 lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum
 28 V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on
 29 nameplate.
 30 D. All open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service
 31 factors.
 32 E. All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be
 33 high efficiency design with full load efficiencies which meet or exceed the values listed below when tested in
 34 accordance with NEMA MG 1.
 35

36 FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED

37 -----Open Drip-Proof Motors-----
 38 MOTOR -----Nominal Motor Speed-----
 39 HP 1200 rpm 1800 rpm 3600 rpm
 40 1 82.5 85.5 77.0
 41 1-1/2 86.5 86.5 84.0
 42 2 87.5 86.5 85.5
 43 3 88.5 89.5 85.5
 44 5 89.5 89.5 86.5
 45 7-1/2 90.2 91.0 88.5
 46 10 91.7 91.7 89.5
 47 15 91.7 93.0 90.2

1	20	92.4	93.0	91.0
2	25	93.0	93.6	91.7
3	30	93.6	94.1	91.7
4	40	94.1	94.1	92.4
5	50	94.1	94.5	93
6	60	94.5	95	93.6
7	75	94.5	95.0	93.6
8				
9		----Totally Enclosed Fan-Cooled----		
10	MOTOR	-----Nominal Motor Speed-----		
11	HP	1200 rpm	1800 rpm	3600 rpm
12	1	82.5	85.5	77.0
13	1-1/2	87.5	86.5	84.0
14	2	88.5	86.5	85.5
15	3	89.5	89.5	86.5
16	5	89.5	89.5	88.5
17	7-1/2	91.0	91.7	89.5
18	10	91.0	91.7	90.2
19	15	91.7	92.4	91.0
20	20	91.7	93.0	91.0
21	25	93.0	93.6	91.7
22	30	93.0	93.6	91.7
23	40	94.1	94.1	92.4
24	50	94.1	94.5	93.0
25	60	94.5	95.0	93.6
26	75	94.5	95.4	93.6

27 **2.2 SINGLE PHASE, SINGLE SPEED MOTORS**

- 28 A. Use NEMA rated 115 volt, single phase, 60 hertz motors for all motors 1/3 HP and smaller.
 29 B. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated
 30 and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

31 **PART 3 - EXECUTION**

32 **3.1 INSTALLATION**

- 33 A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to
 34 get a secure installation.
 35 B. When motor will be flexible coupled to the driven device, mount coupling to the shafts in accordance with the
 36 coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts;
 37 adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches
 38 per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure
 39 concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inch.
 40 C. When motor will be connected to the driven device by means of a belt drive, mount sheaves on the appropriate
 41 shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the
 42 sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After
 43 sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so
 44 that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt
 45 tension and adjust if necessary during the first day of operation and again after several days.
 46 D. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any
 47 reason.

1 E. Lubricate all motors requiring lubrication.

2 **END OF SECTION**

**SECTION 22 05 14
PLUMBING SPECIALTIES**

1
2
3

4 **PART 1 - GENERAL**

5 **1.1 SCOPE**

- 6 A. This section includes specifications for floor drains, cleanouts, backflow preventers, water hammer arrestors and
7 other miscellaneous plumbing specialties.
- 8 B. PART 1 - GENERAL
- 9 1. Scope
- 10 2. Related Documents
- 11 3. Reference
- 12 4. Reference Standards
- 13 5. Quality Assurance
- 14 6. Shop Drawings
- 15 7. Operation and Maintenance Data
- 16 C. PART 2 - PRODUCTS
- 17 1. Floor Drains
- 18 2. Hub Drains
- 19 3. Cleanouts
- 20 4. Water Hammer Arrestors
- 21 5. Backflow Preventers
- 22 6. Wall Hydrants
- 23 7. Hose Bibbs
- 24 8. Garage Catch Basins
- 25 9. Wall Box
- 26 10. Safings
- 27 11. Vent Flashings
- 28 12. Water Meter
- 29 D. PART 3 - EXECUTION
- 30 1. Installation
- 31 2. Construction Verification Items
- 32 3. Agency Training

33 **1.2 RELATED DOCUMENTS**

- 34 A. Section 01 91 01 – Commissioning Process
- 35 B. Section 22 08 00 – Commissioning of Plumbing
- 36 C. Section 22 11 00 - Facility Water Distribution
- 37 D. Section 22 13 00 - Facility Sanitary Sewerage
- 38 E. Section 22 14 00 - Facility Storm Drainage
- 39 F. Section 22 15 13 - General Service Compressed-Air Piping
- 40 G. Section 22 05 23 - General-Duty Valves for Plumbing Piping

41 **1.3 REFERENCE**

- 42 A. Applicable provisions of Division 1 shall govern work under this section.

43 **1.4 REFERENCE STANDARDS**

- 44 A. ANSI A112.21.1 - Floor Drains.
- 45 B. ANSI A112.26.1/PDI WH-201 - Water Hammer Arrestors.
- 46 C. ASSE 1001 - Pipe Applied Atmospheric Type Vacuum Breakers.
- 47 D. ASSE 1010 - Water Hammer Arrestors.
- 48 E. ASSE 1011 - Hose Connection Vacuum Breakers.
- 49 F. ASSE 1012 - Backflow Preventers with Intermediate Atmospheric Vent.
- 50 G. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.

51 **1.5 QUALITY ASSURANCE**

- 52 A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions..

- 1 B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be
2 approved or have pending approval at the time of shop drawing submission.

3 **1.6 SHOP DRAWINGS**

- 4 A. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights,
5 manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

6 **1.7 OPERATION AND MAINTENANCE DATA**

- 7 A. All operations and maintenance data shall comply with the submission and content requirements specified under
8 section GENERAL REQUIREMENTS.

9 **PART 2 - PRODUCTS**

10 **2.1 FLOOR DRAINS**

- 11 A. Manufacturer: Josam, Smith, Wade, Watts, Zurn.
12 B. FD-1: 3" min. (2" min. for single shower drains) enameled cast iron two piece body with double drainage flange,
13 weep holes, reversible clamping adjustable collar, adjustable 6"x6" min. square or round polished nickel-bronze
14 strainer with threaded collar, bottom outlet.
15 C. FD-2: 4" enameled heavy duty cast iron two piece body with double drainage flange, weep holes, heavy duty
16 adjustable 9" round coated cast iron tractor grate strainer, with sediment bucket, bottom outlet. Zurn Z-556-Y

17 **2.2 HUB DRAINS**

- 18 A. Manufacturer: Josam, Smith, Wade, Watts, Zurn.
19 B. HD-1: 3" min. cast iron hub section up 2" min. above floor level, with full-sized P-trap.
20 C. HD-2: 3" min. enameled cast iron bottom outlet floor drain body with membrane clamp, adjustable collar and 3"
21 high extension adapter (less threads on inlet) Zurn Z-415-U (modified) . (For use on above grade installations.) .

22 **2.3 CLEANOUTS**

- 23 A. Manufacturer: Josam, Smith, Wade, Watts, Zurn.
24 B. INTERIOR CONCRETE FLOOR AREAS: Enameled cast iron body with round or square adjustable scoriated polished
25 nickel bronze cover, tapered threaded ABS closure plug. Extra heavy duty Zurn Z-1400- / Z-1400-T.
26 C. INTERIOR CERAMIC TILE FLOOR AREAS: Enameled cast iron body with square adjustable scoriated nickel bronze
27 cover, tapered threaded ABS closure plug. Zurn ZN-1400-T.
28 D. INTERIOR VINYL TILE FLOOR AREAS: Enameled cast iron body with round adjustable scoriated nickel bronze cover,
29 tapered threaded ABS closure plug. Zurn ZN-1400.
30 E. INTERIOR CARPETED FLOOR AREAS: Enameled cast iron body with round adjustable scoriated nickel bronze cover
31 and secured carpet marker, tapered threaded ABS closure plug. Zurn Z-1400-CM.
32 F. INTERIOR FINISHED WALL AREAS: Line type cleanout tee with tapered threaded ABS cleanout plug, round polished
33 stainless steel access cover secured with machine screw. Zurn Z-1446- (Note: Screw shall not pass completely
34 through the ABS plug, trim screw as necessary)
35 G. INTERIOR EXPOSED VERTICAL STACKS: Line type cleanout tee with tapered threaded ABS closure plug. Zurn Z-1445.
36 H. INTERIOR HORIZONTAL LINES: Cast iron hub with tapped ferrule and tapered threaded ABS or PVC closure plug, or
37 no-hub coupling and blind plug.

38 **2.4 WATER HAMMER ARRESTORS**

- 39 A. Manufacturer: PPP Industries, Sioux Chief, Wade, Watts.
40 B. ANSI A112.26.1, ASSE 1010; sized in accordance with PDI WH-201, precharged piston type constructed of hard
41 drawn Type K copper, threaded brass adapter, brass piston with o-ring seals, FDA approved silicone lubricant,
42 suitable for operation in temperature range 35 to 150 degrees F, maximum 250 psig working pressure, 1500 psig
43 surge pressure. Watts series 15.

44 **2.5 BACKFLOW PREVENTERS**

- 45 A. Manufacturers: Beeco, Cla-Val, Conbraco, Febco, Watts, Wilkins.
46 B. HOSE CONNECTION VACUUM BREAKERS: ASSE 1011, brass or bronze construction, EPDM diaphragm and seat, rated
47 for 125 psig and 180°F. Watts 8 (interior application).
48 C. PIPE APPLIED ATMOSPHERIC TYPE VACUUM BREAKERS: ASSE 1001, same size as pipe, brass or bronze construction,
49 silicone disc, rated for 125 psig and 160°F. Watts 288A.

- 1 D. ANTI-SIPHON PRESSURE TYPE VACUUM BREAKERS: ASSE 1020, same size as pipe, brass or bronze construction,
2 silicone disc, plastic seat, stainless steel spring, inlet and outlet ball shutoff valves, test port ball valves, rated for 150
3 psig and 110°F. Watts 800M4QT
- 4 E. HIGH HAZARD ANTI-SIPHON, ANTI-SPILL VACUUM BREAKERS: ASSE 1056, same size as pipe, brass or bronze
5 construction, silicone rubber discs, stainless steel springs, inlet and outlet ball shutoff valves, with test cocks, anti-
6 spill design, rated for 150 psig and 180 deg. F max.. Watts 008QT.
- 7 F. DUAL CHECK WITH ATMOSPHERIC VENT FOR CO₂ POST MIX VENDING MACHINES: 3/8", stainless steel body and
8 parts, dual check with third ball check outlet, rated for 150 psig and 140°F. Watts 9BD.
- 9 G. INTERMEDIATE ATMOSPHERIC VENTED BACKFLOW PREVENTERS: ASSE 1012, same size as pipe, with intermediate
10 atmospheric vent between independent check valves, bronze body with union ends, stainless steel springs, rated for
11 175 psig and 210°F. Watts 9DM.
- 12 H. REDUCED PRESSURE ZONE BACKFLOW PREVENTERS: ASSE 1013 _" reduced pressure zone backflow assembly
13 complete with inlet strainer, inlet and outlet ball or non-rising stem gate isolation valves. Size for maximum pressure
14 drop of __ psig at __ GPM. Constructed of bronze or epoxy coated cast iron body with bronze and plastic internal
15 parts, stainless steel springs, non-threaded vent outlet, 4 test cocks, rated for 175 psig and 210°F, with air gap
16 apparatus on drain. Watts series 919-S-QT-AG, Wilkins #975 or approved equal.
- 17 **2.6 WALL / HYDRANTS**
- 18 A. Manufacturer: Josam, Smith, Wade, Watts, Woodford, Zurn.
- 19 B. WH-1: Freezeproof automatic draining wall hydrant in flush mounted. 3/4" inlet, 3/4" hose thread ASSE 1019-93
20 backflow preventer outlet, loose key operator, polished brass finish. Woodford model 67.
- 21 **2.7 HOSE BIBBS**
- 22 A. HB-1: Bronze or brass construction hose faucet/valve, cast iron handwheel, replaceable disc, hose thread spout,
23 with ASSE 1011 backflow preventer outlet, 3/4" size. Watts model SC-8-3.
- 24 **2.8 GARAGE CATCH BASINS**
- 25 A. Precast reinforced concrete manhole sections, 36" reinforced diameter 20 gallon minimum catch basins, ASTM
26 C478. Construct base of 6" thick precast reinforced concrete or 8" thick cast in place concrete. Construct top of
27 precast reinforced concrete eccentric cone and adjusting rings or 6" thick reinforced concrete slab with concentric
28 opening.
- 29 B. Seal between sections with rubber ring gaskets, ASTM C443, or plastic preformed gasket material. Seal pipe
30 penetrations with flexible watertight rubber gasketed seals.
- 31 C. Steps to be constructed of cast iron or polypropylene coated steel reinforcing rod.
- 32 D. Frame and cover or grate to be cast iron, ASTM A48, Class 35B, of style indicated, with minimum 20" diameter catch
33 basin opening and pickhole.
- 34 **2.9 WALL BOXES**
- 35 A. WB-1: Fire rated steel ice maker wall box, white powder coated finish, with faceplate frame, inturrescent pad, ½"
36 inlet, and NSF quarter turn ball valve. Provided hammer arrester valve.
- 37 B. Fixture: Guy Gray Model FRJB12S
- 38 **2.10 SAFINGS**
- 39 A. Manufacturers: Noble, Dal Seal.
- 40 B. Drain flashing made from Chlorinated Polyethylene with non-woven fiber laminated to both sides and compatible
41 with thin-set waterproof membranes, ANSI A 118.10. NobleFlex.
- 42 C. Sheet membrane manufactured from Chlorinated Polyethylene with polyester fabric laminated to both sides with a
43 nominal thickness of 0.8 ,, (0.30"), ANSI A 118.10.NobelSeal TS.
- 44 **2.11 VENT FLASHINGS**
- 45 A. Manufacturers: Semco, Oatey.
- 46 B. Single Ply Membrane Roofs: Flashing boot of material compatible with roofing membrane with base flange for
47 adhering to membrane and stainless steel drawband for securing to vent pipe.
- 48 **2.12 WATER METER**
- 49 A. Water meter furnished by City of Madison Water Utility. Verify performance of provided meter is as scheduled on
50 the plumbing drawings.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance with
4 manufacturers recommendations.
- 5 B. Set floor drains and cleanouts level and plumb adjusted to finished floor elevation, or finished wall location. Locate
6 where serviceable. Allow minimum of 18" clearance around cleanouts for rodding. Lubricate threaded cleanout
7 plugs with graphite and oil, teflon tape or waterproof grease. Install trap primer connections where indicated.
8 Provide deep seal traps on floor drains and hub drains installed in mechanical rooms, penthouses or rooms with
9 excessive positive or negative pressure.
- 10 C. Floor drains and hub drains installed in public restrooms, locker rooms, seldom used rooms, and areas with minute
11 drainage flow shall have installations of combination trap evaporation/backflow preventer diaphragm installations.
- 12 D. Install water hammer arrestors where indicated and at quick closing valve installations.
- 13 E. Install backflow preventers in accordance with Wis. Dept. of Safety and Professional Services requirements
14 maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap
15 installation from relief opening to above hub drain or floor drain.
- 16 F. Where backflow preventers requiring Dept. of Safety and Professional Services registration are installed, provide
17 initial registration, testing and report filing required by Dept. of Safety and Professional Services. List the name and
18 address of the building that the backflow preventer installations occur in.
- 19 G. Mount hose bibbs securely fastened to wall where indicated. Provide water hammer arrestor in line to hose bibb.
- 20 H. Excavate garage catch basins setting precast bases on granular backfill and pouring cast in place bases on
21 undisturbed soil. Seal joints between base, sections, collars and castings with gasketing material for tightly packed
22 waterproof seals. Adjust casting to match finished floor. Form interior shelves with concrete grout for smooth
23 flowlines conforming to the shape and slope of the sewer. Place piping into garage catch basin providing full support
24 of piping on exterior bedding and insuring pipe seals are properly installed and waterproof. Backfill and compact soil
25 around garage catch basin.
- 26 I. Install safing at floor drains above grade. Extend 12" beyond drains in all directions. Cover entire floor in showers
27 and extend 6" up in walls above curbs and to a height of 6' (3" wide each direction) in corners. Install on concrete
28 floor that is smooth and free of debris. Seal all joints and connect to drain body clamp. Safing is subject to standing
29 water leak test. Install safing at all built-up shower installations. (Note: spray-on and brush applied liquid safing is
30 not acceptable).
- 31 J. Flash vent penetrations through roof. Tighten drawband of membrane boot to vent pipe. Adhere base flashing to
32 deck or membrane. Provide waterproof patch around penetration on existing roofs.

33 **3.2 CONSTRUCTION VERIFICATION ITEMS**

- 34 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 22
35 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

36 **3.3 AGENCY TRAINING**

- 37 A. All training provided for agency shall comply with the format, general content requirements and submission
38 guidelines specified under Section 01 91 01.

39 **END OF SECTION**
40
41
42

**SECTION 22 05 15
PIPING SPECIALTIES**

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for plumbing piping specialties for all piping systems. Included are the following topics:
- B. PART 1 - GENERAL
1. Scope
 2. Related Work
 3. Reference
 4. Reference Standards
 5. Shop Drawings
 6. Operation and Maintenance Data
 7. Design Criteria
- C. PART 2 - PRODUCTS
1. Thermometers
 2. Thermometer Sockets
 3. Test Wells
 4. Test Plugs
 5. Pressure Gauges
 6. Strainers
- D. PART 3 - EXECUTION
1. Thermometers
 2. Thermometer Sockets
 3. Test Wells
 4. Test Plugs
 5. Pressure Gauges
 6. Strainers

1.2 RELATED WORK

- A. Section 01 91 01– Commissioning Process
- B. Section 22 11 00 - Facility Water Distribution
- C. Section 22 13 00 - Facility Sanitary Sewerage
- D. Section 22 14 00 - Facility Storm Drainage
- E. Section 22 15 13 - General Service Compressed-Air Piping
- F. Section 22 05 23 - General-Duty Valves for Plumbing Piping
- G. Section 22 07 00 - Plumbing Insulation
- H. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASTM B650 Electrodeposited Engineering Chromium Coatings on Ferrous Substrates

1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.

1.6 SHOP DRAWINGS

- A. Required for all items in this section. Include materials of construction, dimensional data, ratings/capacities/ranges, approvals, test data, pressure drop data where appropriate, and identification as referenced in this section and/or on the drawings.

1.7 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

- 1 **1.8 DESIGN CRITERIA**
2 A. All piping specialties are to be rated for the highest pressures and temperatures in the respective system in
3 accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

4 **PART 2 - PRODUCTS**

5 **2.1 THERMOMETERS**

- 6 A. Ashcroft, Marsh, Taylor, H. O. Trerice, Ametek/U. S. Gauge, Weiss, Wika, Weksler.
7 B. Stem Type: Cast aluminum case, nine inch scale, clear acrylic window. adjustable angle brass stem with stem of
8 sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any
9 insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:

10	Service	Hot Water
11	Scale Range, °F	30 - 180
12	Increment, °F	2

13 **2.2 THERMOMETER SOCKETS**

- 14 A. Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in
15 pipeline. Furnish with extension necks for insulated piping systems.

16 **2.3 TEST WELLS**

- 17 A. Similar to thermometer sockets except with a brass cap that threads into the inside of the test well to prevent dirt
18 from accumulating. Secure cap to body with a short chain. Furnish with extension necks, where appropriate, to
19 accommodate the pipeline insulation.

20 **2.4 TEST PLUGS**

- 21 A. Brass threaded pressure and temperature test plug with neoprene self-closing valve, valve retainer, brass threaded
22 cap, rated for 150 psi and 0-200 degrees F.

23 **2.5 PRESSURE GAUGES**

- 24 A. Ametek/U. S. Gauge, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Wika, Weksler.
25 B. Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on a
26 white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial,
27 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale, with scale range as
28 follows:

29	Service	Hot Water	Cold Water	Compressed Air
30	Scale Range, psig	0-100	0-100	0-200
31	Increment, psig	1	1	2

- 32 C. Pressure Snubbers: Bronze construction, 300 psig working pressure, 1/4" size.
33 D. Gauge Valves: Use ball valves as specified in Section 22 05 23 - General-Duty Valves for Plumbing Piping.

34 **2.6 STRAINERS**

- 35 A. Armstrong, Illinois, Keckley, Metraflex, Mueller Steam, Sarco, Watts.
36 B. Y type; cast bronze body, ASTM B62; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for
37 a blowoff valve; sweat, threaded or flanged body rated at not less than 150 psi WOG.
38 C. Y type; cast iron body, ASTM A126; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for a
39 blowoff valve; threaded or flanged ends; rated at not less than 150 psi WOG.

40 **PART 3 - EXECUTION**

41 **3.1 THERMOMETERS**

- 42 A. Stem Type: Install in piping systems as indicated on the drawings and/or details using a separable socket in each
43 location.

44 **3.2 THERMOMETER SOCKETS**

- 45 A. Install at each point where a thermometer or temperature control sensing element is located in a pipeline.

1 **3.3 TEST WELLS**
2 A. Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for inserting a
3 thermometer at a later date.

4 **3.4 TEST PLUGS**
5 A. Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for short-term
6 measurement of pressure or temperature.

7 **3.5 PRESSURE GAUGES**
8 A. Install in locations where indicated on the drawings and/or details, with scale range appropriate to the system
9 operating pressures.
10 B. Pressure Snubbers: Install in gauge piping for all gauges used on water services.
11 C. Gauge Valves: Install at each gauge location as close to the main as possible and at each location where a gauge
12 tapping is indicated.

13 **3.6 STRAINERS**
14 A. Install all strainers where indicated allowing sufficient space for the screens to be removed. Install a ball valve in the
15 tapped screen retainer.

16 **END OF SECTION**

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1 **SECTION 22 05 23**
2 **GENERAL DUTY VALVES FOR PLUMBING PIPING**

3 **PART 1 - GENERAL**

4 **1.1 SCOPE**

- 5 A. This section includes valve specifications for all Plumbing systems except where indicated under Related Work.
6 Included are the following topics:
7 B. PART 1 - GENERAL
8 1. Scope
9 2. Related Work
10 3. Reference
11 4. Lead Free Requirements
12 5. Quality Assurance
13 6. Submittals
14 7. Operation and Maintenance Data
15 8. Design Criteria
16 C. PART 2 - PRODUCTS
17 1. Water System Valves
18 2. Ball Valves
19 3. Butterfly Valves
20 4. Spring Loaded Check Valves
21 5. Balance Valves
22 6. Drain Valves
23 7. Compressed Air Systems
24 8. Shut-off Valves
25 9. Safety Exhaust Shut-off Valves
26 10. Pressure Reducing Valves
27 11. Specialty Valves and Valve Accessories
28 12. Gauge Valves
29 13. Safety Relief Valves
30 D. PART 3 - EXECUTION
31 1. General
32 2. Shut-off Valves
33 3. Balancing Valves
34 4. Drain Valves
35 5. Spring Loaded Check Valves
36 6. Pressure Reducing Valves
37 7. Safety Relief Valves
38 8. Compressed Air Valves

39 **1.2 RELATED WORK**

- 40 A. Section 01 91 01– Commissioning Process
41 B. Section 22 05 00 Common Work Results for Plumbing
42 C. Section 22 05 14 - Plumbing Specialties
43 D. Section 22 30 00 - Plumbing Equipment

44 **1.3 REFERENCE**

- 45 A. Applicable provisions of Division 1 govern work under this section.

46 **1.4 LEAD FREE REQUIREMENTS**

- 47 A. All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings
48 and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per the Federal Safe
49 Drinking Water Act as amended January 4th 2011 Section 1417.

50 **1.5 QUALITY ASSURANCE**

- 51 A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

- 1 **1.6 SUBMITTALS**
2 A. Schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature
3 ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.
- 4 **1.7 OPERATION AND MAINTENANCE DATA**
5 A. All operations and maintenance data shall comply with the submission and content requirements specified under
6 section GENERAL REQUIREMENTS.
- 7 **1.8 DESIGN CRITERIA**
8 A. ANSI Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
9 B. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
10 C. Where valve types (ball, butterfly, etc.) are specified for individual plumbing services (i.e. domestic water, etc.),
11 each valve type shall be of the same manufacturer unless prior written approval is obtained from the Owner.
12 D. Valves to be line size unless specifically noted otherwise.

13 **PART 2 - PRODUCTS**

14 **2.1 WATER SYSTEM VALVES**

- 15 A. All water system valves to be rated at not less than 125 water working pressure at 240 degrees F unless noted
16 otherwise.
17 B. Ball valves:
18 1. 3" and smaller: Two piece bronze body; sweat, threaded or ASTM F1960 joint connection ends, full port
19 stainless steel ball and stem; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof
20 stem; 600 psig WOG. Provide valve stem extensions for valves installed in all piping with insulation. Nibco
21 585-70-66 LF or equal by Apollo, Milwaukee, Watts.
22 C. Butterfly valves:
23 1. 2-1/2" and larger: Cast or ductile iron body; stainless steel shaft; bronze, copper or teflon bushings; EPDM
24 resilient seat; EPDM seals; EPDM encapsulated ductile iron or stainless steel disc. 200 psig WOG through 12.
25 Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use tapped lug
26 type valves with stud bolts or cap screws, or grooved end connection valves, permitting removal of
27 downstream piping while using the valve for system shutoff. Nibco LD-2022 or GD-4765, or equal by
28 Milwaukee, Victaulic or Watts.
29 2. Provide 10 position locking lever handle actuators for valves 6" and smaller. Provide worm gear operators
30 with external position indication for valves 8" and larger.
31 D. Spring loaded check valves:
32 1. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel
33 center guide pin, Class 125, teflon seat unless only bronze available. ConBraCo 61 series, Nibco S480-Y-LF,
34 Watts LF600 or equal.
35 2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless
36 steel spring, stainless steel stem if stem is required, Class 125. Hammond IR9253 or IR9354, Milwaukee 1400
37 or 1800 series, Nibco W910-LF or F910-LF.
38 E. Balance valves:
39 1. 2" and smaller: Brass body, 304 stainless steel ball, sweat or threaded ends, glass filled teflon seat, brass
40 readout valves with EPT checks, with adjustable memory stop position indicator and extended handle stem,
41 suitable for 300 psig water working pressure at 200 degrees F. B&G Xylem Circuit Setter Plus CB1SLF/CB-1LF,
42 or equal by Nibco or Watts.
43 F. Drain valves:
44 1. 3/4 inch ball valve with integral threaded hose adapter, sweat or threaded inlet connections, with threaded
45 cap and chain on hose threads, Apollo 70LF-200-HC, Milwaukee BA-100H or BA-150H Hammond 8501H or
46 8511H or equal by Nibco, or Watts.

47 **2.2 COMPRESSED AIR SYSTEMS**

- 48 A. Shut-off valves:
49 1. 3" and smaller: Two piece bronze body; threaded ends, chrome plated bronze ball; glass filled teflon seat;
50 teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Apollo 70-100, Milwaukee
51 BA100, Nibco T585-70 or T-590-Y, Watts B-6000.
52 B. Safety exhaust shut-off valves:

- 1 1. 3" and smaller: Two or three piece bronze body; threaded ends, chrome plated bronze ball; downstream
2 vent port; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 175 psig
3 WOG. Apollo 70-100-41, Watts B-6000, Milwaukee or Nibco equals.
4 C. Pressure reducing valves:
5 1. Bronze or aluminum body and trim, diaphragm or balanced piston, 250 psig maximum, 0-125 psig adjustable
6 output, internal relief, 1/4" outlet gauge tapping.

7 **2.3 SPECIALTY VALVES AND VALVE ACCESSORIES**

- 8 A. Gauge valves:
9 1. Use 1/4" ball valves. Needle valves and gauge cocks will not be accepted.
10 B. Safety relief valves:
11 1. Bronze body, temperature and pressure actuated, stainless steel stem and spring, thermostat with non-
12 metallic coating, test lever, suitable for 125 psig water working pressure at 240 degrees F, sized for full BTUH
13 input and operating pressure of equipment, with valve capacity on metal label. For equipment less than or
14 equal to 200,000 BTUH input, provide AGA, UL or ASME listed and labeled valve. Provide ASME listed and
15 labeled valve for larger equipment. Bell & Gossett, A. W. Cash, Conbraco, Watts, Wilkins. Temperature and
16 pressure relief valve shall be sized per AGA rating for BTUH input, Re: SPS 382.40(5)(d).

17 **PART 3 - EXECUTION**

18 **3.1 GENERAL**

- 19 A. Properly align piping before installation of valves. Install and test valves in strict accordance with valve
20 manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
21 B. Mount valves in locations which allow access for operation, servicing and replacement.
22 C. Provide valve handle extensions for all valves installed in insulated piping.
23 D. Install all valves with the stem in the upright or horizontal position. If possible, install butterfly valves with the
24 stem in the horizontal position. Valves installed with the stems down will not be accepted.
25 E. Prior to flushing of piping systems, place all valves in the full-open position.

26 **3.2 SHUT-OFF VALVES**

- 27 A. Install shut-off valves at each piece of equipment, at each branch take-off from mains for isolation or repair and
28 elsewhere as indicated.

29 **3.3 BALANCING VALVES**

- 30 A. Install where indicated on the drawings and details for balancing of flow in pumped hot water recirculation piping
31 systems.
32 B. Upon project completion, adjust each valve and set position stop. Balance system to minimum flow in return
33 piping branches needed to maintain even supply water temperature throughout building.

34 **3.4 DRAIN VALVES**

- 35 A. Provide drain valves for complete drainage of all systems. Locations of drain valves include low points of piping
36 systems, downstream of riser isolation valves, equipment locations specified or detailed, other locations required
37 for drainage of systems and elsewhere as indicated.

38 **3.5 SPRING LOADED CHECK VALVES**

- 39 A. Install a spring loaded check valve in each circulating pump discharge line, each clearwater sump pump discharge
40 line and elsewhere as indicated.

41 **3.6 PRESSURE REDUCING VALVES**

- 42 A. Provide ball valve and strainer at inlet and ball valve at outlet. Install pressure gauges to indicate inlet and outlet
43 pressure at each pressure reducing valve.

44 **3.7 SAFETY RELIEF VALVES**

- 45 A. Install relief valves on all pressure vessels and elsewhere as indicated. Inlet and outlet piping connecting to valves
46 must be the same size as valve connections or larger. Pipe discharge to drain where indicated or to floor.

- 1 **3.8 COMPRESSED AIR VALVES**
2 A. Install shut-off valves at each piece of equipment, base of drip legs and elsewhere as indicated. Install safety
3 exhaust shut-off valves at terminal equipment designed for frequent removal. Install pressure reducing valves at
4 filter stations and elsewhere as indicated. Mount in readily accessible location for gauge and maintenance access.

5 **END OF SECTION**

1 **SECTION 22 05 29**
2 **HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

3 **PART 1 - GENERAL**

4 **1.1 SCOPE**

- 5 A. This section includes specifications for supports of all plumbing equipment and materials as well as piping system
6 anchors. Included are the following topics:
7 B. PART 1 - GENERAL
8 1. Scope
9 2. Related Work
10 3. Reference
11 4. Reference Standards
12 5. Quality Assurance
13 6. Description
14 7. Shop Drawings
15 8. Design Criteria
16 C. PART 2 - PRODUCTS
17 1. Manufacturers
18 2. Structural Supports
19 3. Pipe Hangers and Supports
20 4. Beam Clamps
21 5. Riser Clamps
22 6. Concrete Inserts
23 7. Anchors
24 8. Equipment Stands
25 9. Corrosive Atmosphere Coatings
26 D. PART 3 - EXECUTION
27 1. Installation
28 2. Hanger and Support Spacing
29 3. Riser Clamps
30 4. Concrete Inserts
31 5. Anchors

32 **1.2 RELATED WORK**

- 33 A. Section 01 91 01 – Commissioning Process
34 B. Section 03100 & 03300 - Concrete formwork and cast-in-place concrete for equipment pads.
35 C. Section 22 07 00 - Plumbing Insulation for insulation protection at support devices.

36 **1.3 REFERENCE**

- 37 A. Applicable provisions of Division 1 shall govern work under this section.

38 **1.4 REFERENCE STANDARDS**

- 39 A. MSS SP-58

40 **1.5 REFERENCE**

- 41 A. Applicable provisions of Division 1 govern work under this section.

42 **1.6 QUALITY ASSURANCE**

- 43 A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

44 **1.7 DESCRIPTION**

- 45 A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All support
46 and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.
47 B. Do not hang any mechanical item directly from a metal deck or run piping so its rests on the bottom chord of any
48 truss or joist.
49 C. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

- 1 D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of
- 2 equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- 3 E. Protect insulation at all hanger points; see Related Work above.

4 **1.8 SHOP DRAWINGS**

- 5 A. Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and
- 6 type of service.
- 7 B. All submittals are to comply with submission and content requirements specified with in section [17 00 00].

8 **1.9 DESIGN CRITERIA**

- 9 A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58
- 10 unless noted otherwise.
- 11 B. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation
- 12 supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is
- 13 greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3
- 14 support distance.

15 **PART 2 - PRODUCTS**

16 **2.1 MANUFACTURERS**

- 17 A. Anvil, B-Line, Pate, G-Strut, Piping Technology, Roof Products & Systems or approved equal.

18 **2.2 STRUCTURAL SUPPORTS**

- 19 A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles,
- 20 channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically
- 21 indicated on the drawings.

22 **2.3 PIPE HANGERS AND SUPPORTS**

- 23 A. Hangers for Pipe Sizes 1/2" through 2":
 - 24 1. Carbon steel, adjustable swivel ring. B-Line B3170NF, Anvil 69 or 70.
 - 25 2. Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- 26 B. Hangers for Pipe Sizes 2" and Larger:
 - 27 1. Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- 28 C. Multiple or Trapeze Hangers:
 - 29 1. Steel channels with welded spacers and hanger rods.
- 30 D. Wall Support:
 - 31 1. Carbon steel welded bracket with hanger. B-Line 3068 Series, Anvil 194 Series.
 - 32 2. Perforated, epoxy painted finish, 16-12 gauge, min., steel channels securely anchored to wall structure, with
 - 33 interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000
 - 34 series clamps, Anvil type PS 200 H with PS 1200 clamps. When copper piping is being supported, provide
 - 35 flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid
 - 36 contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp
 - 37 and cushion assemblies, B-Line BVT series, Anvil PS 1400 series.
- 38 E. Vertical Support:
 - 39 1. Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.
- 40 F. Floor Support:
 - 41 1. Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.
- 42 G. Copper Pipe Supports:
 - 43 1. All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or
 - 44 polyvinylchloride coated. Where steel channels are used, provide isolation collar between
 - 45 supports/clamps/fasteners and copper piping.

46 **2.4 PIPE HANGER RODS**

- 47 A. Steel Hanger Rods:
 - 48 1. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
 - 49 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.

1 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed
2 the limits indicated.

	Maximum Load (Lbs.)	Rod Diameter
	(650°F Maximum Temp.)	(inches)
3	610	3/8
4	1130	1/2
5	1810	5/8
6	2710	3/4
7	3770	7/8
8	4960	1
9	8000	1-1/4

12 **2.5 BEAM CLAMPS**

- 13 A. MSS SP-58 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a
14 retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set
15 screw. B-Line B3036L/B3034, Anvil 86/92.
16 B. MSS SP-58 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod
17 sizes to 1-1/2 inch diameter. B-Line B3054, Anvil 228.

18 **2.6 CONCRETE INSERTS**

- 19 A. Drilled Fasteners:
20 1. Carbon steel drop-in type expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit
21 of same manufacturer as anchor. Hilti, Rawl, Redhead.

22 **2.7 ANCHORS**

- 23 A. Use welding steel shapes, plates, and bars to secure piping to the structure.

24 **2.8 EQUIPMENT STANDS**

- 25 A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust
26 inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere
27 coatings.

28 **2.9 CORROSIVE ATMOSPHERE COATINGS**

- 29 A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM
30 A123, 1.5 ounces/square foot of surface each side. Mechanical galvanized threaded products, ASTM B695 Class 50,
31 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to
32 factory coating.
33 B. Corrosive atmospheres include the following locations:
34 1. Bus parking area
35 2. Oil storage
36 3. Battery storage
37 4. Bus washing area
38 5. Chemical storage and hazardous waste storage rooms
39 6. Sanitary pumping stations
40 7. Locker rooms
41 8. Bus maintenance area

42 **PART 3 - EXECUTION**

43 **3.1 INSTALLATION**

- 44 A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.
45 B. Install supports to provide for free expansion of the piping system. Support all piping from the structure using
46 concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets
47 securely to the structure and test to demonstrate the adequacy of the fastening.
48 C. Coordinate hanger and support installation to properly group piping of all trades.
49 D. Trim steel hanger rods to within one inch of the final lock nut position. Hanger and support cutoff burrs shall be
50 removed and sharp edges ground smooth.

- 1 E. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural
2 shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe
3 supporting devices made specifically for use with the channels may be substituted for the specified supporting
4 devices provided that similar types are used and all data is submitted for prior approval.
5 F. Size and install hangers and supports, except for riser clamps, for installation on the exterior of piping insulation.
6 Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly
7 on piping.
8 G. Perform welding in accordance with standards of the American Welding Society.

9 **3.2 HANGER AND SUPPORT SPACING**

- 10 A. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
11 B. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
12 C. Use hangers with 1-1/2 inch minimum vertical adjustment.
13 D. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
14 E. Support riser piping independently of connected horizontal piping.
15 F. Adjust hangers to obtain the slope specified in the piping section of these specifications.
16 G. Space hangers for pipe as follows:

<u>Pipe Material</u>	<u>Pipe Size</u>	<u>Max. Horiz. Spacing</u>	<u>Max. Vert. Spacing</u>
Cast Iron	2" and larger	5'-0"	15'-0"
Copper	1/2" through 3/4"	5'-0"	10'-0"
Copper	1" through 1-1/4"	6'-0"	10'-0"
Copper	1-1/2" through 2-1/2"	8'-0"	10'-0"
Copper	3"	10'-0"	10'-0"
Copper	4" and larger	12'-0"	10'-0"
Ductile Iron	All	10'-0"	20'-0"
Steel	1/2" through 1-1/4"	7'-0"	15'-0"
Steel	1-1/2" through 6"	10'-0"	15'-0"
Steel	8" through 12"	14'-0"	20'-0"
Steel	14" and over	20'-0"	20'-0"
Plastic	Drain and Vent	4'-0"	10'-0"

30 **3.3 RISER CLAMPS**

- 31 A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the
32 building structure below at each floor.

33 **3.4 CONCRETE INSERTS**

- 34 A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Furnish
35 inserts to the General Contractor for placement in concrete formwork. Use inserts for suspending hangers from
36 reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement
37 section for inserts carrying pipe over 4 inch size. Where concrete slabs form finished ceiling, provide inserts that
38 are flush with the slab surface.

39 **3.5 ANCHORS**

- 40 A. Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of
41 principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of
42 anchors as required to accommodate both expansion and contraction of piping.

43 **END OF SECTION**
44
45

**SECTION 22 07 00
PLUMBING INSULATION**

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes insulation specifications for plumbing piping and equipment. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference Standards
 - 4. Quality Assurance
 - 5. Description
 - 6. Definitions
 - 7. Shop Drawings
 - 8. Operation and Maintenance Data
- C. PART 2 - PRODUCTS
 - 1. Materials
 - 2. Insulation & Jackets
 - 3. Accessories
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Piping, Valve and Fitting Insulation
 - 3. Equipment Insulation
 - 4. Construction Verification Items

1.2 RELATED WORK

- A. Section 01 91 01 – Commissioning Process
- B. Section 22 08 00 – Commissioning of Plumbing
- C. Section 22 05 00 - Common Work Results for Plumbing
- D. Section 22 11 00 - Facility Water Distribution
- E. Section 22 13 00 - Facility Sanitary Sewerage
- F. Section 22 14 00 - Facility Storm Drainage
- G. Section 22 15 13 - General Service Compressed-Air Piping
- H. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- I. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate
- B. ASTM C165 Test Method for Compressive Properties of Thermal Insulations
- C. ASTM C177 Heat Flux and Thermal Transmission Properties
- D. ASTM C195 Mineral Fiber Thermal Insulation Cement
- E. ASTM C240 Cellular Glass Insulation Block
- F. ASTM C302 Density of Preformed Pipe Insulation
- G. ASTM C303 Density of Preformed Block Insulation
- H. ASTM C449 Mineral Fiber Hydraulic Setting Thermal Insulation Cement
- I. ASTM C518 Heat Flux and Thermal Transmission Properties
- J. ASTM C533 Calcium Silicate Block and Pipe Thermal Insulation
- K. ASTM C534 Preformed Flexible Elastomeric Thermal Insulation
- L. ASTM C547 Mineral Fiber Preformed Pipe Insulation
- M. ASTM C552 Cellular Glass Block and Pipe Thermal Insulation
- N. ASTM C553 Mineral Fiber Blanket and Felt Insulation
- O. ASTM C578 Preformed, Block Type Cellular Polystyrene Thermal Insulation
- P. ASTM C591 Preformed Rigid Cellular Polyurethane Thermal Insulation

- 1 Q. ASTM C610 Expanded Perlite Block and Thermal Pipe Insulation
- 2 R. ASTM C612 Mineral Fiber Block and Board Thermal Insulation
- 3 S. ASTM C921 Properties of Jacketing Materials for Thermal Insulation
- 4 T. ASTM C1136 Flexible Low Permeance Vapor Retarders for Thermal Insulation
- 5 U. ASTM E84 Surface Burning Characteristics of Building Materials
- 6 V. MICA National Commercial & Industrial Insulation Standards
- 7 W. NFPA 225 Surface Burning Characteristics of Building Materials
- 8 X. UL 723 Surface Burning Characteristics of Building Materials

9 **1.5 QUALITY ASSURANCE**

- 10 A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- 11 B. Label all insulating products delivered to the construction site with the manufacturer's name and description of
- 12 materials.

13 **1.6 DESCRIPTION**

- 14 A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation.
- 15 The following types of insulation are specified in this section:
- 16 1. Pipe Insulation
- 17 2. Equipment Insulation
- 18 B. Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association)
- 19 Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where
- 20 specifically modified in these specifications, or where prior written approval has been obtained from the Owners
- 21 Project Representative.

22 **1.7 DEFINITIONS**

- 23 A. Concealed: shafts, furred spaces, space above finished ceilings. All other areas, shall be considered as exposed.

24 **1.8 SHOP DRAWINGS**

- 25 A. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods,
- 26 fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's
- 27 technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation
- 28 instructions.

29 **1.9 OPERATION AND MAINTENANCE DATA**

- 30 A. All operations and maintenance data shall comply with the submission and content requirements specified under
- 31 section GENERAL REQUIREMENTS.

32 **PART 2 - PRODUCTS**

33 **2.1 MATERIALS**

- 34 A. Materials or accessories containing asbestos will not be accepted.
- 35 B. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread
- 36 rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:
- 37 C. Insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed
- 38 rating no higher than 150.

39 **2.2 INSULATION AND JACKETS**

- 40 A. Manufacturers: Armstrong, Certainteed Manson, Childers, Dow, Extol, Halstead, H.B. Fuller, Imcoa, Knauf, Owens-
- 41 Corning, Pittsburgh Corning, Rubatex, Johns-Mansville, or approved equal.
- 42 B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be
- 43 suitable to receive jackets, adhesives and coatings as indicated.
- 44 C. ELASTOMERIC INSULATION:
- 45 1. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than
- 46 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor
- 47 transmission of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20
- 48 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.
- 49 D. POLYOLEFIN INSULATION:

- 1 1. Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than
2 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor
3 transmission of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service
4 range of -165 degrees F to 210 degrees F.
- 5 E. PHENOLIC INSULATION:
- 6 1. Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.13
7 at 75 degrees F, minimum compressive strength of 31 psi parallel and 18 psi perpendicular, maximum water
8 vapor transmission 0.117 perm inch, maximum water absorption of .5% by volume, rated for service range
9 of -290 degrees F to 250 degrees F.
- 10 2. Kraft reinforced foil vapor barrier laminate all service jacket, factory applied to insulation with a self-sealing
11 pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture
12 resistance of 50 units.
- 13 F. EXTRUDED POLYSTYRENE INSULATION:
- 14 1. Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.2
15 at 75 degrees F, minimum compressive strength of 35 psi, maximum water vapor transmission of 1.1 perm
16 inch, maximum water absorption of .1% by volume, rated for service range of -290 degrees F to 165 degrees
17 F.
- 18 G. URETHANE INSULATION:
- 19 1. Rigid closed cell polyisocyanurate, minimum nominal density of 1.8 lbs. per cu. ft., thermal conductivity of
20 not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 19 psi parallel and 10
21 psi perpendicular, maximum water vapor transmission of 4 perm inch, maximum water absorption of .2%
22 by volume, rated for service range of -290 degrees F to 300 degrees F.
- 23 H. CELLULAR GLASS INSULATION:
- 24 1. Rigid closed cell, minimum nominal density of 8.5 lbs. per cu. ft., thermal conductivity of not more than 0.36
25 at 50 degrees F, minimum compressive strength of 100 psi, maximum water vapor transmission of 0.0 perm
26 inch, maximum water absorption of .2% by volume, rated for service range of -450 degrees F to 900 degrees
27 F.

28 2.3 JACKETS

- 29 A. PVC FITTING COVERS AND JACKETS (PFJ):
- 30 1. White PBC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU.
31 Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation,
32 in kitchens or food processing areas or installed outdoors. Jacket thickness to be minimum .02: indoors/.03"
33 outdoors for piping 12" and smaller, .03: indoors/.04" outdoors for piping or ductwork 15" and larger.
- 34 B. ALL SERVICE JACKETS (ASJ):
- 35 1. Heavy duty, fire retardant material with white kraft reinforced foil vapor retarding jacket, factory applied to
36 insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 pers and
37 minimum beach puncture resistance of 50 units.

38 2.4 INSULATION INSERTS AND PIPE SHIELDS

- 39 A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products
- 40 B. Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12" and larger, supplement
41 with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be
42 minimum 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping. On
43 roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.
- 44 C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses,
45 gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product
46 described above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate
47 provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.
- 48 D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent insulation
49 may be substituted for calcium silicate inserts with one 1" x 6" block for piping through 2-1/2" and three 1" x 6"
50 blocks for piping through 4". Submit shield schedule to demonstrate equivalency to pre-engineered/pre-
51 manufactured product described above.
- 52 E. Wood blocks will not be accepted.

53 2.5 ACCESSORIES

- 54 A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at
55 operating temperatures of the systems to which they are applied.

- 1 B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications
- 2 specified.
- 3 C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015
- 4 inch for aluminum and .010 inch for stainless steel.
- 5 D. Tack fasteners to be stainless steel ring grooved shank tacks.
- 6 E. Staples to be clinch style.
- 7 F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
- 8 G. Finishing cement to be ASTM C449.
- 9 H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
- 10 I. Bedding compounds to be non-shrinking and permanently flexible.
- 11 J. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.
- 12 K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

13 **PART 3 - EXECUTION**

14 **3.1 INSTALLATION**

- 15 A. Install insulation, jackets and accessories in accordance with manufacturers instructions and under ambient
- 16 temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and dry.
- 17 B. Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing,
- 18 inspection and any necessary repairs have been successfully completed.
- 19 C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted.
- 20 Cover and seal exposed fiberglass insulation when insulation is terminated, no raw fiberglass insulation is allowed.
- 21 Provide neat and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation
- 22 terminates. Install with longitudinal joints facing wall or ceiling.
- 23 D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
- 24 E. Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces
- 25 cut undersize and stretched to fit will not be accepted.
- 26 F. Insulation shall be continuous through sleeves and openings. Vapor barriers shall be maintained continuous through
- 27 all penetrations.
- 28 G. Provide a complete vapor barrier for insulation on the following systems:
- 29 1. Cold water (potable and non-potable)
- 30 2. Storm Water
- 31 3. Equipment piping with a surface temperature below 65 degrees F

32 **3.2 PROTECTIVE JACKET INSTALLATION**

- 33 A. PVC FITTING COVERS AND JACKETS (PF J):
- 34 1. Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent recommended
- 35 by jacket manufacturer. Lap slip joint ends 4: without fasteners where required to absorb expansion and
- 36 contraction. For sections where vapor retarding jacket is not required and jacket requires routine removal,
- 37 tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For systems requiring a vapor
- 38 retarding jacket, apply a 1-1/2: band of mastic over ends, throat, seams and penetrations.
- 39 B. ALL SERVICE JACKETS (ASJ) and FOIL SCRIM ALL SERVICE JACKETS (F SJ)
- 40 1. Install according to manufacturer's recommendations using factory supplied lap seals and butt strip seals.

41 **3.3 PIPING, VALVE, AND FITTING INSULATION**

- 42 A. General:
- 43 1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket
- 44 seams and 2" tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along
- 45 seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.
- 46 2. Water supply piping insulation shall be continuous throughout the building and installed adjacent to and
- 47 within building walls to a point directly behind the fixture that is being supplied.
- 48 3. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior
- 49 of insulation. Where a vapor barrier is not required, hangers and supports may be attached directly to
- 50 piping with insulation completely covering hanger or support and jacket sealed at support rod penetration.
- 51 Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation
- 52 and vapor barrier jacketing/coating around riser clamp.
- 53 B. Insulation Inserts and Pipe Shields:

- 1 1. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on
 2 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.
 3 C. Fittings and Valves:
 4 1. Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up
 5 insulation of the same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic
 6 or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack
 7 fasteners and 1-1/2" band of mastic over ends, throat, seams or penetrations. On systems requiring vapor
 8 barrier, use vapor barrier mastic.
 9 D. Elastomeric and Polyolefin:
 10 1. Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings
 11 allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight
 12 installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyolefin, seal
 13 factory pregglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to
 14 both surfaces.
 15 E. Protective Jackets:
 16 1. Provide a protective PVC jacket for the following insulated piping: All exposed piping.
 17 2. Lap seams and joints a minimum of 2 inches and continuously seal with welding solvent recommended by
 18 jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and
 19 contraction. For sections where vapor barrier is not required and jacket requires routine removal, tack
 20 fasteners may be used.
 21 F. Pipe Insulation Schedule:
 22 1. Provide insulation on new and existing remodeled piping as indicated in the following schedule:
 23
 24
 25

Service	Insulation Types	Insulation Thickness by Pipe Size				
		<1"	1" to <1 1/2"	1-1/2" to < 4"	4" to" < 8"	8" and larger
Hot Water Supply	Closed Cell	1"	1"	1.5"	1.5"	1.5"
Hot Water Circulating	Closed Cell	1"	1"	1.5"		
Cold Water	Closed Cell	0.5"	0.5"	1"	1"	1"
Tempered Water	Closed Cells	0.5"	0.5"	1"		
Non-Potable Cold Water	Closed Cell	0.5"	0.5"	1"		
All Horizontal Storm Piping and 4'-0" of vertical Piping thereafter, & Roof Drain bodies	Closed Cell	0.5"	0.5"	0.5"	0.5"	0.5"
Clearwater Waste	Closed Cell	0.5"	0.5"	0.5"	0.5"	0.5"

- 36 * = Elastomeric & Phenolic types are acceptable
 37 The following piping and fittings are not to be insulated:
 38 • Chrome plated exposed supplies and stops (except where specifically noted).
 39 • Water hammer arrestors.
 40 • Piping unions and flanges for systems not requiring a vapor barrier.
 41
 42
 43
 44
 45
 46
 47

48 **3.4 EQUIPMENT INSULATION**

- 49 A. Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at
 50 these locations.
 51 B. ELASTOMERIC/POLYOLEFIN:
 52 1. Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation
 53 with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.
 54 C. Equipment Insulation Schedule:
 55 1. Provide equipment insulation as follows:
 56

	Equipment	Insulation Type	Thickness	Remarks
1				
2	Water Meter	Elastomeric	1/2"	Sheet type, fabricated for ease of removal and replacement when service is required.
3				
4	Water Softener	Elastomeric	1/2"	Sheet type, fabricated for ease of removal and replacement when service is required.
5				
6	Water Filters	Elastomeric	1/2"	Sheet type, pipe size type or combination of both.
7				Fabricated for ease of removal and replacement when testing and servicing is required
8				
9	R.P.B.P.	Elastomeric	½"	Sheet type, pipe size type or combination of both.
10				Fabricated for ease of removal and replacement when testing and servicing is required
11				

12 **3.5 CONSTRUCTION VERIFICATION ITEMS**

13 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 22
14 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

15 **END OF SECTION**

16

SECTION 22 08 00
COMMISSIONING OF PLUMBING

1
2

3 **PART 1 - GENERAL**

4 **1.1 SCOPE**

5 A. This section includes commissioning forms for construction verification and functional performance testing.
6 Included are the following topics:

7 B. PART 1 - GENERAL

- 8 1. Scope
- 9 2. Related Work
- 10 3. Reference
- 11 4. Submittals

12 C. PART 2 - PRODUCTS

- 13 1. (Not Used)

14 D. PART 3 – EXECUTION

- 15 1. Commissioning Forms
 - 16 a. CV-22 05 14 Backflow Preventers
 - 17 b. CV-22 07 00 Plumbing Insulation
 - 18 c. CV-22 11 00 Facility Water Distribution
 - 19 d. CV-22 13 00 Facility Sanitary Sewerage
 - 20 e. CV-22 14 00 Facility Storm Drainage
 - 21 f. CV-22 15 13 General Service Compressed Air Piping
 - 22 g. CV-22 30 00 Inline Centrifugal Pumps
 - 23 h. CV-22 30 00 Water Heaters (Electric)
 - 24 i. CV-22 30-00 Water Softeners
 - 25 j. CV-22 42 00 Commercial Plumbing Fixtures
 - 26 k. CV-22 60 00 Air Compressors
 - 27 l. CV-22 60 00 Refrigerated Air Dryers
 - 28 m. FPT-22 30 00 Inline Centrifugal Pump
 - 29 n. FPT-22 30 00 Water Heaters

30 **1.2 RELATED WORK**

31 A. Section 01 91 01 – Commissioning Process

32 **1.3 REFERENCE**

33 A. Applicable provisions of Division 1 shall govern work under this section.

34 **1.4 SUBMITTALS**

- 35 A. Reference the General Conditions of the Contract for submittal requirements.
- 36 B. Reference Section 01 91 01 Commissioning Process for Construction Verification Checklist and Functional
- 37 Performance Test submittal requirements.

38 **PART 2 - PRODUCTS**

39 A. (Not Used)

40 **PART 3 - EXECUTION**

41 A. COMMISSIONING FORMS

- 42 1. Commissioning forms are to be filled in as work progresses by the individuals responsible for
- 43 installation and shall be completed for each installation phase.
- 44 2. Provide a description of the work completed since the last entry, the percentage of the total work
- 45 completed for the system for that area and the step of installation or finalization.

- 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
3. Circle Yes or No for each commissioning form item. If the information requested for an item does not apply to the given stage of installation for the system, list it as "N/A". Explain all discrepancies, negative responses or N/A responses in the negative responses section.
 4. Once the work is 100% complete and the responses to each item are complete and resolved for a given commissioning forms group, mark as complete, initial and date in the spaces provided.
 5. Provide copies of the commissioning forms to the commissioning agent 2 days prior to construction progress meetings.

Construction Verification Checklist
22 05 14 – Plumbing Specialties

CV-22 05 14 – Backflow Preventers

Equipment Identification/Tag: _____

Location: _____

Group/Item	Group/Task Description	Submitted	Delivered
<i>A</i>	<i>MODEL VERIFICATION</i>		
1	Manufacturer		
2	Model		
3	Serial Number		
4	Configuration		
5	Size (in)		
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>B</i>	<i>PHYSICAL CHECKS</i>		
1	Unit is free from physical damage.	YES	NO
2	All components present.	YES	NO
3	Installation and startup manual provided.	YES	NO
4	Regulated Object number affixed.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>C</i>	<i>INSTALLATION</i>		
1	Unit supported as required by manufacturer and specifications.	YES	NO
2	Equipment location coordinated with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances.	YES	NO
3	Adequate clearance around unit for service.	YES	NO
4	Floor drain / floor sink provided beneath or near unit.	YES	NO
5	Configuration and orientation of unit complies with labeling and literature from manufacturer, and DSPS code requirements.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>D</i>	<i>WATER PIPING</i>		
1	All piping components have been installed (in the correct order) as required by contract document or manufacturer.	YES	NO
2	Strainer provided prior to unit.	YES	NO
3	Piping supported as required by specifications.	YES	NO
4	Piping is clean.	YES	NO
5	Piping and valves properly checked and free of leaks.	YES	NO
6	Piping insulation is complete, labeled, and installed as per specifications.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Construction Verification Checklist
22 05 14 – Plumbing Specialties

Negative Responses

Group/ Item	Date Found	Found By	Reason for Negative Response	Resolved	Date Resolved	Resolution
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		

Construction Verification Checklist
22 07 00 – Plumbing Insulation

CV-22 07 00 – Plumbing Insulation

Equipment Identification/Tag: _____

Location: _____

PIPING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)										
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE				INITIALS: _____		DATE: _____								

Question Details

- 1) Piping clean, dry, pressure tested and approved prior to application of insulation.
- 2) Type and thickness of insulation complies with listed specification requirements for given system and pipe size.
- 3) Insulation installed with smooth and even surfaces, without the use of filler in voids.
- 4) Butt joints and longitudinal seams closed tightly with a minimum of 2" lap on jacket seams and 2" tape on butt joints.
- 5) Staples along seams and butt joints provided with vapor barrier mastic provided for staples on systems requiring vapor barrier.
- 6) Full-length material used as possible, with no scrap piecing or stretching of insulation utilized.
- 7) Insulation continuous through sleeves and openings with vapor barriers continuous through all penetrations.
- 8) Complete vapor barrier provided for all cold water, storm water and piping systems with surface temperatures below 65°F.
- 9) Exposed fiberglass insulation covered and sealed at all permanent terminations and at end of work day.
- 10) Piping and direction of flow is labeled per specification requirements.

Construction Verification Checklist
22 07 00 – Plumbing Insulation

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 07 00 – Plumbing Insulation

B) VALVE, FITTING & EQUIPMENT INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)						
				1)	2)	3)	4)	5)	6)	
				YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:					DATE:		

Question Details

- 1) Fittings, valves, unions, flanges, couplings and specialties insulated with factory molded or built up insulation of the same thickness as adjoining insulation.
- 2) Insulated fittings, valves, unions, flanges, couplings and specialties covered with fabric reinforcing and mastic or where temperatures do not exceed 150°F, PVC fitting covers.
- 3) PVC fitting covers secured with tack fasteners and 1-1/2" band of mastic over ends, throat, seams or penetrations or for systems requiring vapor barrier, vapor barrier mastic.
- 4) Equipment access manholes, fittings, nameplates or ASME stamps left uninsulated with insulation beveled and sealed at these locations.
- 5) Equipment insulation installed with smooth and even surfaces per specifications requirements.
- 6) No insulation provided at chrome plated exposed supplies and stops (except where specifically noted), water hammer arrestors, and piping unions and flanges for piping systems not requiring a vapor barrier.

Construction Verification Checklist
22 07 00 – Plumbing Insulation

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 11 00 – Facility Water Distribution

CV-22 11 00 – Facility Water Distribution

Equipment Identification/Tag: _____

Location: _____

A) PRE-INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)			
				1)	2)	3)	
				YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE				INITIALS:	_____	DATE:	_____

Question Details

- 1) All piping, valves, etc. are clean and free of damage prior to installation.
- 2) Temporary protective coating is provided on cast iron and steel valves during storage.
- 3) Temporary end caps are provided on piping and fittings until installation.

Construction Verification Checklist
22 11 00 – Facility Water Distribution

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 11 00 – Facility Water Distribution

B) GENERAL PIPING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)										
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:							DATE:				

Question Details

- 1) Piping is free to expand and contract without noise or damage to hangers, joints, or the building.
- 2) Piping is installed in a manner to ensure that insulation will not contact adjacent surfaces.
- 3) Piping is installed with sufficient pitch and arranged in a manner to ensure drainage of entire system.
- 4) Changes in pipe sizes are made with the proper size reducing fittings, reducing elbow or reducing tees, and no bushings are utilized.
- 5) Connections between dissimilar pipe materials are made with dielectric fittings.
- 6) Pipe hanger spacing complies with specification requirements.
- 7) All equipment requiring maintenance is accessible (valves, strainers, etc.).
- 8) Piping allows access to equipment that is part of this system or another system.
- 9) Water piping not installed within exterior walls.
- 10) Open pipe ends capped at completion of work day.

Construction Verification Checklist
22 11 00 – Facility Water Distribution

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 11 00 – Facility Water Distribution

C) UNDERGROUND PIPING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)							
				1)	2)	3)	4)	5)	6)	7)	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:					DATE:			

Question Details

- 1) Exterior water piping installed below predicted frost level in accordance with SPS Table 382.30-6, but in no case less than 6' bury depth to top of pipe.
- 2) Minimum of 8' horizontal distance maintained between 2-1/2" and larger water piping and sanitary sewer piping.
- 3) Minimum of 30" horizontal and 12" vertical distance, water on top, maintained between 2" and smaller water piping and sanitary sewer piping.
- 4) Where water piping crosses a sanitary sewer, minimum 18" vertical clearance add waterproof PVC water pipe sleeve (reference sanitary sewer materials) sealed at both ends for distance of 10' from sewer in both directions provided.
- 5) Thrust restraints provided for 3" and larger exterior water piping joints, hydrants, caps, plugs, fittings and bends of 22-1/2 degrees or more.
- 6) Excavation and backfill meet specification requirements.
- 7) Underground warning tape installed 6"-12" below finished grade above all exterior below ground piping.
- 8) Pipe and fittings encased in a polyethylene wrap per specification.

Construction Verification Checklist
22 11 00 – Facility Water Distribution

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 11 00 – Facility Water Distribution

D) VALVE & FITTING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)							
				1)	2)	3)	4)	5)	6)	7)	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:					DATE:			

Question Details

- 1) All valves are in a horizontal or upright vertical position (not inverted) with handles in an accessible position.
- 2) Valve handle extensions are provided where needed per the specification.
- 3) Drainage valves provided at all low points and downstream of riser isolation valves.
- 4) Isolation valves provided at all equipment connections, main branches and sub-branches, “T” connections, and as necessary for repairing the system as specified in contract documents.
- 5) Riser shutoff valve and a capped hose thread drain valve at the bottom of each riser provided.
- 6) All strainers in piping system have ball valves installed at the tapped screen retainer.
- 7) Yard and wall hydrants installed with discharge above minimum grade clearance requirements noted in specifications.

Construction Verification Checklist
22 11 00 – Facility Water Distribution

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 11 00 – Facility Water Distribution

E) TESTING CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)								
				1)	2)	3)	4)	5)	6)	7)	8)	
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:					DATE:				

Question Details

- 1) Piping tested utilizing water at specified pressure and duration as per specification.
- 2) All leaks identified during testing have been repaired and test re-done until satisfactory conditions are accomplished.
- 3) Test conducted with all piping of tested system or section visible during testing.
- 4) Proceeding system chlorination, all outlets flushed for a minimum of 1 minute with clean water until water runs clear.
- 5) Following initial flush system filled with water and chlorine at 50 PPM and allowed to stand for 24 hours, or system filled and with a water solution containing at least 200 PPM of chlorine and allowed to stand for 3 hours.
- 6) Following specification prescribed stand times for chlorine treatment system flushed until chlorine levels are at source water levels.
- 7) 24 hours after final flushing, water samples of the number and location specified by the Engineer taken for lab testing and results show the absence of coliform bacteria.

Construction Verification Checklist
22 11 00 – Facility Water Distribution

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 11 00 – Facility Water Distribution

F) FINALIZATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)			
				1)	2)	3)	4)
				YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:			DATE:	

Question Details

- 1) All exposed piping which passes through a wall, ceiling or floor is provided with escutcheon plates.
- 2) Piping labels and direction of flow is provided per specification requirements.
- 3) All penetrations through fire rated wall assemblies have been sealed per specification requirements.
- 4) All penetrations through non-rated wall assemblies have been sealed per specification requirements for given space type.

Construction Verification Checklist
22 11 00 – Facility Water Distribution

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 13 00 – Facility Sanitary Sewerage

CV-22 13 00 – Facility Sanitary Sewerage

Equipment Identification/Tag: _____

Location: _____

A) PRE-INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)		
				1)	2)	3)
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE				INITIALS: _____		DATE: _____

Question Details

- 1) All piping meets ASTM standards and specifications.
- 2) All piping, etc. is clean and free of damage prior to installation.
- 3) Temporary protective covering is provided on pipe and fittings during storage.

Construction Verification Checklist
22 13 00 – Facility Sanitary Sewerage

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 13 00 – Facility Sanitary Sewerage

B) GENERAL PIPING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials											
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:						DATE:					

Question Details

- 1) Piping is free to expand and contract without noise or damage to hangers, joints, or the building.
- 2) Piping is installed with sufficient pitch and arranged in a manner to ensure drainage of entire system.
- 3) Interior piping pitched to drain at minimum slope of 1/4" per foot where possible and in no case less than 1/8" per foot for piping 3" and larger.
- 4) Changes in pipe sizes are made with the proper size reducing fittings, reducing elbow or reducing tees, and no bushings are utilized.
- 5) Pipe hanger spacing complies with specification requirements.
- 6) All equipment requiring maintenance is accessible (valves, strainers, etc.).
- 7) Drains and cleanouts level and plumb to finished floor, roof or finished wall.
- 8) Minimum clearance of 18" provided for all cleanouts and backwater valves.

Construction Verification Checklist
22 13 00 – Facility Sanitary Sewerage

9) Open pipe ends capped at completion of work day.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 13 00 – Facility Sanitary Sewerage

C) UNDERGROUND PIPING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)							
				1)	2)	3)	4)	5)	6)		
				YES	YES	YES	YES	YES	YES		
				NO	NO	NO	NO	NO	NO		
				YES	YES	YES	YES	YES	YES		
				NO	NO	NO	NO	NO	NO		
				YES	YES	YES	YES	YES	YES		
				NO	NO	NO	NO	NO	NO		
				YES	YES	YES	YES	YES	YES		
				NO	NO	NO	NO	NO	NO		
				YES	YES	YES	YES	YES	YES		
				NO	NO	NO	NO	NO	NO		
				YES	YES	YES	YES	YES	YES		
				NO	NO	NO	NO	NO	NO		
				YES	YES	YES	YES	YES	YES		
				NO	NO	NO	NO	NO	NO		
<input type="checkbox"/> CHECKLIST GROUP COMPLETE				INITIALS:				DATE:			

Question Details

- 1) Exterior piping installed below predicted frost level, but in no case less than 5' bury depth to top of pipe.
- 2) Minimum of 8' horizontal distance maintained between 2-1/2" and larger water piping and sanitary sewer piping.
- 3) Minimum of 30" horizontal and 12" vertical distance, water on top, maintained between 2" and smaller water piping and sanitary sewer piping.
- 4) Where water piping crosses a sanitary sewer, minimum 18" vertical clearance and waterproof PVC water pipe sleeve (reference sanitary sewer materials) sealed at both ends for distance of 10' from sewer in both directions provided.
- 5) Excavation and backfill procedures meet specification requirements.
- 6) Piping bedding and backfill materials meet specification requirements.
- 7) Underground warning tape installed 6"-12" below finished grade above all exterior below ground piping.
- 8) Non-metallic piping has tracer wire installed per Wisconsin Administrative Plumbing Codes.

Construction Verification Checklist
22 13 00 – Facility Sanitary Sewerage

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 13 00 – Facility Sanitary Sewerage

D) TESTING & FINALIZATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)								
				1)	2)	3)	4)	5)	6)	7)	8)	
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE				INITIALS: _____				DATE: _____				

Question Details

- 1) Piping tested utilizing water at specified pressure and duration as per specification for given piping system type.
- 2) All leaks identified during testing have been repaired and test re-done until satisfactory conditions are accomplished.
- 3) Test conducted with all piping of tested system or section visible during testing.
- 4) Entire testing procedure witnessed by DFD Representative per the specifications.
- 5) Piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) flushed with high flow of water at completion of project to demonstrate full flow capacity.
- 6) Blockages removed and necessary repairs made where flow is found to be impeded during flushing test.
- 7) Piping identification and direction of flow is provided per specification requirements.
- 8) All penetrations through fire rated wall assemblies have been sealed per specification requirements.
- 9) All penetrations through non-rated wall assemblies have been sealed per specification requirements for given space type.

Construction Verification Checklist
22 13 00 – Facility Sanitary Sewerage

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
 22 14 00 – Facility Storm Drainage

CV-22 14 00 – Facility Storm Drainage

Equipment Identification/Tag: _____

Location: _____

A) PRE-INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)		
				1)	2)	3)
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE				INITIALS:	_____	DATE: _____

Question Details

- 1) Piping materials meet specified ASTM standards and the specifications.
- 2) All piping, etc. is clean and free of damage prior to installation.
- 3) Temporary protective covering is provided on pipe and fittings during storage.

Construction Verification Checklist
22 14 00 – Facility Storm Drainage

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 14 00 – Facility Storm Drainage

B) GENERAL PIPING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)										
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:							DATE:				

Question Details

- 1) Piping is free to expand and contract without noise or damage to hangers, joints, or the building.
- 2) Piping is installed in a manner to ensure that insulation will not contact adjacent surfaces.
- 3) Piping is installed with sufficient pitch and arranged in a manner to ensure drainage of entire system.
- 4) Changes in pipe sizes are made with the proper size reducing fittings, reducing elbow or reducing tees, and no bushings are utilized.
- 5) Connections between dissimilar pipe materials are made with approved fittings.
- 6) Pipe hanger spacing complies with specification requirements.
- 7) All equipment requiring maintenance is accessible.
- 8) Piping allows access to equipment that is part of this system or another system.
- 9) Minimum clearance of 18” provided for all cleanouts.
- 10) Open pipe ends capped at completion of work day.

Construction Verification Checklist
22 14 00 – Facility Storm Drainage

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 14 00 – Facility Storm Drainage

C) UNDERGROUND PIPING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)				
				1)	2)	3)	4)	5)
				YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:			DATE:		

Question Details

- 1) Exterior piping installed below predicted frost level, but in no case less than 5' bury depth to top of pipe.
- 2) Excavation and backfill procedures meet specification requirements.
- 3) Bedding and backfill material meet specifications.
- 4) Tracer wire is installed on non-metallic piping.
- 5) Underground warning tape installed 6"-12" below finished grade above all exterior below ground piping.

Construction Verification Checklist
22 14 00 – Facility Storm Drainage

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 14 00 – Facility Storm Drainage

D) TESTING & FINALIZATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)							
				1)	2)	3)	4)	5)	6)	7)	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:						DATE:		

Question Details

- 1) Piping tested utilizing water at specified pressure and duration as per specification for given piping system type.
- 2) All leaks identified during testing have been repaired and test re-done until satisfactory conditions are accomplished.
- 3) Test conducted with all piping of tested system or section visible during testing.
- 4) All testing procedures witnessed by DFD representative.
- 5) Piping identification and direction of flow is provided per specification requirements.
- 6) All penetrations through fire rated wall assemblies have been sealed per specification requirements.
- 7) All penetrations through non-rated wall assemblies have been sealed per specification requirements for given space type.

Construction Verification Checklist
22 14 00 – Facility Storm Drainage

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 15 13 – General Service Compressed Air Piping

22 15 13 – General Service Compressed Air Piping

Equipment Identification/Tag: _____

Location: _____

A) PRE-INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)			
				1)	2)	3)	4)
				YES	YES	YES	YES
				NO	NO	NO	NO
				YES	YES	YES	YES
				NO	NO	NO	NO
				YES	YES	YES	YES
				NO	NO	NO	NO
				YES	YES	YES	YES
				NO	NO	NO	NO
				YES	YES	YES	YES
				NO	NO	NO	NO
				YES	YES	YES	YES
				NO	NO	NO	NO
				YES	YES	YES	YES
				NO	NO	NO	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE				INITIALS: _____		DATE: _____	

Question Details

- 1) All pipe materials and fittings meet the specifications.
- 2) All piping, valves, etc. are clean and free of damage prior to installation.
- 3) Temporary protective coating is provided on steel valves during storage.
- 4) Temporary end caps are provided on piping and fittings until installation.

Construction Verification Checklist
22 15 13 – General Service Compressed Air Piping

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 15 13 – General Service Compressed Air Piping

B) PIPING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	NO	NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:						DATE:				

Question Details

- 1) Piping is secured to assure damage to hangers, joints, or the building structure does not take place.
- 2) Piping is installed with sufficient pitch and arranged in a manner to ensure drainage of entire system.
- 3) Changes in pipe sizes are made with the proper size reducing fittings, reducing elbow or reducing tees, and no bushings are utilized.
- 4) 4" minimum depth dirt leg installed at the bottom of each vertical run and at each outlet connection with shutoff valve at bottom of dirt leg.
- 5) Pipe hanger spacing complies with specification requirements.
- 6) All valves are in an upright vertical position with handles in a horizontal position and fully operated without removal or alteration of handle.
- 7) Isolation valves provided at all equipment connections, main branches and sub-branches, "T" connections, and as necessary for repairing the system as specified in contract documents.
- 8) Vibration isolation is installed where identified in the contract documents.
- 9) Open pipe ends capped at completion of work day.

Construction Verification Checklist
22 15 13 – General Service Compressed Air Piping

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 15 13 – General Service Compressed Air Piping

E) TESTING & FINALIZATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)							
				1)	2)	3)	4)	5)	6)	7)	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
				YES	YES	YES	YES	YES	YES	YES	
				NO	NO	NO	NO	NO	NO	NO	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE			INITIALS:					DATE:			

Question Details

- 1) Piping tested at 150 psig for a duration of 24 hours with air.
- 2) All leaks identified during testing have been repaired and test re-done until no leaks are present.
- 3) Test conducted with all piping of tested system or section visible during testing.
- 4) All exposed piping which passes through a wall, ceiling or floor is provided with escutcheon plates.
- 5) Piping labels and direction of flow is provided per specification requirements.
- 6) All penetrations through fire rated wall assemblies have been sealed per specification requirements.
- 7) All penetrations through non-rated wall assemblies have been sealed per specification requirements for given space type.

Construction Verification Checklist
22 15 13 – General Service Compressed Air Piping

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 30 00 – Plumbing Equipment

22 30 00 – Inline Centrifugal Pumps

Equipment Identification/Tag: _____

Location: _____

Group/Item	Group/Task Description	Submitted	Delivered
<i>A</i>	<i>MODEL VERIFICATION</i>		
1	Manufacturer		
2	Model		
3	Serial Number		
4	Pump Type		
5	Inlet / Outlet Size (in)	/	/
6	Impeller Diameter (in)		
7	Capacity / Head (gpm / ft w.g.)	/	/
8	Motor Speed / Power (rpm / hp)	/	/
9	Voltage / Phase / Frequency (V / - /Hz)	/ /	/ /
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>B</i>	<i>PHYSICAL CHECKS</i>		
1	Unit is free from physical damage.	YES	NO
2	Openings are sealed with plastic.	YES	NO
3	All components present.	YES	NO
4	Installation and startup manual provided.	YES	NO
5	Unit tags affixed.	YES	NO
6	Manufacturer's ratings readable/accurate	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Submitted	Delivered
<i>C</i>	<i>INSTALLATION</i>		
1	Unit secured as required by manufacturer and specifications.	YES	NO
2	Equipment location coordinated with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances.	YES	NO
3	Adequate clearance around unit for service.	YES	NO
4	All components accessible for maintenance.	YES	NO
5	Unit labeled and is easy to see.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Submitted	Delivered
<i>D</i>	<i>WATER PIPING</i>		
1	All piping components have been installed (in the correct order) as required by contract document or manufacturer.	YES	NO
2	Piping arranged for ease of unit removal.	YES	NO
3	Piping supported as required by specifications.	YES	NO
4	Piping is clean.	YES	NO
5	Unit connected to water system return piping using unions or flanges and isolation valves.	YES	NO
6	Dielectric fittings installed to isolate dissimilar pipe materials.	YES	NO
7	Piping and valves properly checked and free of leaks.	YES	NO
8	Thermometers and pressure gauges supplied on supply and return lines.	YES	NO
9	Piping insulation is complete and installed as per specifications.	YES	NO
10	All valves and test ports are easily accessible.	YES	NO
11	Valve tags attached.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Construction Verification Checklist
22 30 00 – Plumbing Equipment

Group/Item	Group/Task Description	Response	
<i>E</i>	<i>ELECTRICAL</i>		
1	Local disconnect installed in accessible and visible location.	YES	NO
2	Each motor terminal box is connected with a minimum 12", maximum 36" piece of flexible conduit to a fixed junction box.	YES	NO
3	Motor rotation in the proper direction.	YES	NO
4	All electrical connections are tight.	YES	NO
5	All electrical components are grounded.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____
<i>F</i>	<i>CONTROLS INSTALLATION (if applicable)</i>		
1	Remote start and stop wiring installed and communication verified.	YES	NO
2	Remote status wiring installed and communication verified.	YES	NO
3	Aqua-stat wiring installed and communication verified.	YES	NO
4	Timer wiring installed.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____
<i>G</i>	<i>MECHANICAL STARTUP</i>		
1	Unit checked, aligned, and certified prior to startup and report submitted.	YES	NO
2	Unit and motor lubricated before startup.	YES	NO
3	Pump shaft rotates easily with power turned off.	YES	NO
4	System flushed, filled, and air purged.	YES	NO
5	System starts and runs without any unusual noise or vibration.	YES	NO
6	Manufacturer's startup checklist completed and attached.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____
<i>H</i>	<i>CONTROLS STARTUP (if applicable)</i>		
1	Aqua-stat temperature set point set and verified.	YES	NO
2	Lead/lag sequence verified and acceptable.	YES	NO
3	Timer schedule programmed and operation verified.	YES	NO
4	Control wiring labeled per specification requirements.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Negative Responses

Group/Item	Date Found	Found By	Reason for Negative Response	Resolved	Date Resolved	Resolution
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		

Construction Verification Checklist
22 30 00 – Plumbing Equipment

CV-22 30 00 – Water Heaters (Electric)

Equipment Identification/Tag: _____

Location: _____

Group/Item	Group/Task Description	Submitted	Delivered
<i>A</i>	<i>MODEL VERIFICATION</i>		
1	Manufacturer		
2	Model		
3	Serial Number		
4	Heating Input (kW)		
5	Voltage / Phase / Frequency (V / - / Hz)		
6	Storage Capacity (gal.)		
7	Recovery capacity at 100 deg. F rise (gph)		
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>B</i>	<i>PHYSICAL CHECKS</i>		
1	Unit is free from physical damage.	YES	NO
2	Water and gas openings are sealed with plastic plugs.	YES	NO
3	All components present.	YES	NO
4	Installation and startup manual provided.	YES	NO
5	Unit tags affixed.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>C</i>	<i>INSTALLATION</i>		
1	Unit secured as required by manufacturer and specifications.	YES	NO
2	Equipment location coordinated with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances.	YES	NO
3	Unit is set on concrete housekeeping pad and is level (commercial units ONLY).	YES	NO
4	Adequate clearance around unit for service.	YES	NO
5	All components accessible for maintenance.	YES	NO
6	Drain pan installed and piped to an adequate drain.	YES	NO
7	Proper clearances from combustible surfaces maintained per manufacturer's instructions and applicable codes.	YES	NO
8	Unit labeled and is easy to see.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>D</i>	<i>WATER PIPING</i>		
1	All piping components have been installed (in the correct order) as required by contract document or manufacturer.	YES	NO
2	Piping arranged for ease of unit removal.	YES	NO
3	Piping supported as required by specifications.	YES	NO
4	Piping is clean.	YES	NO
5	Unit connected to water supply and return/make-up piping using unions or flanges and isolation valves.	YES	NO
6	Dielectric fittings installed to isolate dissimilar pipe materials.	YES	NO
7	Piping and valves properly checked and free of leaks.	YES	NO
8	Thermometers and pressure gauges supplied on supply and return lines.	YES	NO
9	Piping insulation is complete and installed as per specifications.	YES	NO
10	All valves and test ports are easily accessible.	YES	NO
11	Valve tags attached.	YES	NO

Construction Verification Checklist
22 30 00 – Plumbing Equipment

Group/Item	Group/Task Description	Response	
12	Pressure and temperature relief valve(s) for correct pressure and temperature installed.	YES	NO
13	Pressure and temperature relief valve(s) piped with sufficient pipe diameter to drain designed for boiling water.	YES	NO
14	Drain valve installed.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____
<i>E</i>	<i>ELECTRICAL</i>		
1	Local disconnect installed in accessible and visible location.	YES	NO
2	All electrical connections are tight.	YES	NO
3	All electrical components are grounded.		
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____
<i>F</i>	<i>MECHANICAL STARTUP</i>		
1	System flushed, filled, and air purged.	YES	NO
2	Temperature setting adjusted to correct temperature per contract documents.	YES	NO
3	Pressure and temperature relief valve(s) set to proper pressure and temperature and manually checked for functionality.	YES	NO
4	Manufacturer's startup checklist completed and attached.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Negative Responses

Group/Item	Date Found	Found By	Reason for Negative Response	Resolved	Date Resolved	Resolution
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		

Construction Verification Checklist
CV-22 30 00 – Plumbing Equipment

CV-22 30 00 – Water Softeners

Equipment Identification/Tag: _____

Location: _____

Group/Item	Group/Task Description	Submitted	Delivered
<i>A</i> MODEL VERIFICATION			
1	Manufacturer		
2	Model		
3	Serial Number		
4	Min. exchange capacity @ salt dosage (gr @ lb)	@	@
5	Max. exchange capacity @ salt dosage (gr @ lb)	@	@
6	Peak flow / pressure drop (gpm / psi)	/	/
7	Continuous flow / pressure drop (gpm / psi)	/	/
8	Inlet / outlet pipe sizes (in)	/	/
9	Voltage / Phase / Frequency (V / - /Hz)	/ /	/ /
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>B</i> PHYSICAL CHECKS			
1	Unit is free from physical damage.	YES	NO
2	Openings are sealed with plastic plugs.	YES	NO
3	All components present.	YES	NO
4	Installation and startup, operation and maintenance manual provided.	YES	NO
5	Unit tags affixed.	YES	NO
6	Specified accessories provided	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>C</i> INSTALLATION			
1	Unit secured as required by manufacturer and specifications.	YES	NO
2	Unit is set on concrete housekeeping pad and is level.	YES	NO
3	Equipment location coordinated with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances.	YES	NO
4	Adequate clearance around unit for service.	YES	NO
5	Minimum of 24" provided above brine tank.	YES	NO
6	All components accessible for maintenance.	YES	NO
7	Unit labeled and is easy to see.	YES	NO
8	Specified accessories installed and hardness test kit turned over to Owner.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>D</i> WATER PIPING			
1	All piping components have been installed (in the correct order) as required by contract document or manufacturer.	YES	NO
2	Piping arranged for ease of unit removal.	YES	NO
3	Unit has been provided with bypass piping.	YES	NO
4	Piping supported as required by specifications.	YES	NO
5	Piping is clean.	YES	NO
6	Unit connected to water supply and return piping using unions or flanges and isolation valves.	YES	NO
7	Dielectric fittings installed to isolate dis-similar pipe materials.	YES	NO
8	Piping and valves properly checked and free of leaks.	YES	NO
9	Thermometers and pressure gauges supplied on supply and return lines.	YES	NO
10	Piping insulation is complete and installed as per specifications.	YES	NO

Construction Verification Checklist
CV-22 30 00 – Plumbing Equipment

Group/Item	Group/Task Description	Response	
11	All valves and test ports are easily accessible.	YES	NO
12	Valve tags attached.	YES	NO
13	Drain valve installed and piped to nearest drain.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____
<i>E</i> ELECTRICAL			
1	Local disconnect or plug connection installed in accessible and visible location.	YES	NO
2	All electrical connections are tight.	YES	NO
3	All electrical components are grounded.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____
<i>F</i> MECHANICAL STARTUP			
1	Brine tank is filled with salt and correct level of water.	YES	NO
2	Local controller programmed and operational.	YES	NO
3	Media loaded per Manufacturer's requirements	YES	NO
4	Manufacturer's startup checklist completed and attached.	YES	NO
5	Exchange rate, salt dosage, regeneration cycle times, consumption, backflow rate, brine flow rate, 12 hour standby tank cycle, variable reserve and proportional brining, etc. adjusted to contract document requirements.	YES	NO
6	Operation and maintenance training of Owner's staff using O&M manual completed.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Untreated Water	Treated Water
<i>G</i> WATER TESTING			
1	Hardness (mg/l or grains/gal)		
2	pH		
3	Iron (mg/l and ppm)		
4	Chlorine (ppm)		
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>H</i> EFFICIENCY CERTIFICATION			
1	Pre-Certified through Third Party testing	YES	NO
2	Certified by manufacturer's engineering calculation approved w/ submittal	YES	NO
3	Certified by field sampling, meter analysis and adjustment	YES	NO
	Field sampling and meter analysis data confirming efficiency		
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Negative Responses

Group/Item	Date Found	Found By	Reason for Negative Response	Resolved	Date Resolved	Resolution
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		

Construction Verification Checklist
22 42 00 – Commercial Plumbing Fixtures

CV-22 42 00 – Commercial Plumbing Fixtures

Equipment Identification/Tag: _____

Location: _____

A) INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)								
				1)	2)	3)	4)	5)	6)	7)	8)	9)
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
				YES	YES	YES	YES	YES	YES	YES	YES	YES
				NO	NO	NO	NO	NO	NO	NO	NO	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE				INITIALS: _____		DATE: _____						

Question Details

- 1) Fixture traps and service stops easily accessible for service.
- 2) Fixture and carriers secured per manufacturer requirements and level and plumb to finished surface.
- 3) Pipe penetrations covered with escutcheons.
- 4) Openings between walls, floors and fixtures sealed with mildew-resistant silicone sealant same color as fixture.
- 5) Fixtures tested and fully operational.
- 6) Fixture valves adjusted for intended water flow rate to fixtures to eliminate splashing, noise or overflow
- 7) Self-closing lavatory faucets adjusted to 15 second cycle.
- 8) Shower valve temperature limit stops set to 110 degree maximum outlet temperature.
- 9) Fixtures and trim cleaned using manufacturer's recommended cleaning methods and materials.

Construction Verification Checklist
22 42 00 – Commercial Plumbing Fixtures

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

Construction Verification Checklist
22 60 00 – Gas and Vacuum Systems for laboratories and Healthcare Facilities

CV-22 60 00 – Air Compressors

Equipment Identification/Tag: _____

Location: _____

Group/Item	Group/Task Description	Submitted	Delivered
<i>A</i>	<i>MODEL VERIFICATION</i>		
1	Manufacturer		
2	Model		
3	Serial Number		
4	Capacity (scfm @ psi)	@	@
5	Receiver capacity (gal)		
6	Power / Speed (hp / rpm)		
7	Voltage / Phase / Frequency (V / - / Hz)	/ /	/ /
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>B</i>	<i>PHYSICAL CHECKS</i>		
1	Unit is free from physical damage.	YES	NO
2	The air openings are sealed with plastic plugs.	YES	NO
3	All components present.	YES	NO
4	Installation and startup manual provided.	YES	NO
5	Unit tags affixed.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>C</i>	<i>INSTALLATION</i>		
1	Unit secured as required by manufacturer and specifications.	YES	NO
2	Unit is isolated from the building structure (to reduce vibration and noise)	YES	NO
3	Adequate clearance around unit for service.	YES	NO
4	All components accessible for maintenance.	YES	NO
5	Unit labeled and is easy to see.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>D</i>	<i>PIPING</i>		
1	All piping components have been installed (in the correct order) as required by contract document or manufacturer.	YES	NO
2	Piping arranged for ease of unit removal.	YES	NO
3	Piping supported as required by specifications.	YES	NO
4	Piping is clean.	YES	NO
5	Pressure relief valve installed and is operational.	YES	NO
6	Automatic condensate drain piped to nearest floor drain.	YES	NO
7	Cartridge filter-silencer with pre and post isolation valves installed in piping for each compressor.	YES	NO
8	Piping and valves properly checked and free of leaks.	YES	NO
9	Valve tags attached.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>E</i>	<i>ELECTRICAL</i>		
1	Local disconnect installed in accessible and visible location.	YES	NO
2	Motor rotation in the proper direction	YES	NO
3	All electrical connections are tight.	YES	NO
4	All electrical components are grounded.	YES	NO
5	Each motor terminal box is connected with a minimum 12", maximum 36" piece of flexible conduit to a fixed junction box.	YES	NO

Construction Verification Checklist
22 60 00 – Gas and Vacuum Systems for laboratories and Healthcare Facilities

Group/Item	Group/Task Description	Response	
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____
<i>F</i>	<i>MECHANICAL STARTUP</i>		
1	Belt sheaves have been properly aligned per the specifications.	YES	NO
2	Belt tension has been reviewed and adjusted after start-up of unit and again after 80 hours of operation.	YES	NO
3	Motor / compressor rotation is in the proper direction	YES	NO
4	System starts and runs free from unusual noise or vibration	YES	NO
5	Manufacturer's startup checklist completed and attached	YES	NO
6	Protective shrouds for belts in place and secure	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Negative Responses

Group/Item	Date Found	Found By	Reason for Negative Response	Resolved	Date Resolved	Resolution
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		

Construction Verification Checklist
22 60 00 – Gas and Vacuum Systems for Laboratories and Healthcare Facilities

CV-22 60 00 – Refrigerated Air Dryers

Equipment Identification/Tag: _____

Location: _____

Group/Item	Group/Task Description	Submitted	Delivered
<i>A</i>	<i>MODEL VERIFICATION</i>		
1	Manufacturer		
2	Model		
3	Serial Number		
4	Duty		
5	Refrigerant Type		
6	Capacity (scfm @ psi)		
7	Power (hp)		
8	Voltage / Phase / Frequency (V / - / Hz)		
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	
<i>B</i>	<i>PHYSICAL CHECKS</i>		
1	Unit is free from physical damage.	YES	NO
2	The air and water openings are sealed with plastic plugs.	YES	NO
3	All components present.	YES	NO
4	Installation and startup manual provided.	YES	NO
5	Unit tags affixed.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>C</i>	<i>INSTALLATION</i>		
1	Unit secured as required by manufacturer and specifications.	YES	NO
2	Unit is isolated from the building structure (to reduce vibration and noise)	YES	NO
3	Adequate clearance around unit for service.	YES	NO
4	All components accessible for maintenance.	YES	NO
5	Unit labeled and is easy to see.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>D</i>	<i>PIPING</i>		
1	All piping components have been installed (in the correct order) as required by contract document or manufacturer.	YES	NO
2	Piping arranged for ease of unit removal.	YES	NO
3	Piping supported as required by specifications.	YES	NO
4	Piping is clean.	YES	NO
5	Automatic drain piped to nearest floor drain.	YES	NO
6	Piping and valves properly checked and free of leaks.	YES	NO
7	Valve tags attached.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>E</i>	<i>ELECTRICAL</i>		
1	Local disconnect installed in accessible and visible location.	YES	NO
2	All electrical connections are tight.	YES	NO
3	All electrical components are grounded.	YES	NO
4	Each motor terminal box is connected with a minimum 12", maximum 36" piece of flexible conduit to a fixed junction box.	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Group/Item	Group/Task Description	Response	Response
<i>F</i>	<i>MECHANICAL STARTUP</i>		
1	System starts and runs free from unusual noise or vibration	YES	NO

Construction Verification Checklist
 22 60 00 – Gas and Vacuum Systems for Laboratories and Healthcare Facilities

Group/Item	Group/Task Description	Response	
2	Manufacturer's startup checklist completed and attached	YES	NO
<input type="checkbox"/> CHECKLIST GROUP COMPLETE		INITIALS: _____	DATE: _____

Negative Responses

Group/Item	Date Found	Found By	Reason for Negative Response	Resolved	Date Resolved	Resolution
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		

FPT-22 30 00 – Inline Centrifugal Pump

Equipment Identification/Tag: _____

Location: _____

Test Duration

Date: _____ Start Time: _____ End Time _____

Estimated Duration: _____

Cx Provider(s): _____

Applicable Equipment: _____

Objectives

This test is performed to investigate the functionality of inline centrifugal pumps.

Instrumentation

Instrument	Accuracy	Measurement
N/A	N/A	N/A

Stated Sequence

To be defined by A/E and commissioning provider at completion of construction documents.

Sampling Set

All units and all sequences.

Procedure

1. Lead/Lag
 - a. Have associated system and/or building automation system start and call for lead pump to run.
 - b. Verify that lead pump is energized and that building automation system reflects unit is operational.
 - c. De-energize pump via local disconnect switch.
 - d. Verify lag pump is energized and building automation system reflects status of each unit.
 - e. Return system to normal operation.
2. Aquastat
 - a. Record temperature setpoint of aquastat.
 - b. Record current temperature of water loop.
 - c. Adjust aquastat setpoint to be 10° below current loop temperature.
 - d. Verify pump is energized and allow to stabilize for 10 minutes.
 - e. Return system to normal operation.
 - f. Verify pump de-energizes.
3. Run Schedule
 - a. Verify pump is in run mode. If not override system into run mode.
 - b. Verify pump energizes.
 - c. Change run schedule for current time to be in down mode.
 - d. Verify pump de-energizes.
 - e. Return schedule to originally programmed values.

Results

Lead/Lag:

Functional Performance Test
22 30 00 – Plumbing Equipment

Lead pump is energized when associated system commands? YES NO
Lag pump is energized on lead pump failure? YES NO

Aquastat:

Aquastat Temperature Setpoint: _____
Water Temperature: _____

Pump is energized when loop temperature falls below aquastat setpoint? YES NO

Run Schedule:

Pump is energized during scheduled run period? YES NO
Pump is de-energized during scheduled down period? YES NO

Conclusion

Acceptable Criteria: Pump is energized when called upon by its associated system, aquastat or timer, and that lag pump (if applicable) is energized upon loss of power or failure of lead pump.

Comments:

Observations:

Final Status: Accepted Not Accepted

Relevant Trend Data

Pump run status

Witnesses

Name	Signature
_____	_____
_____	_____
_____	_____
_____	_____

FPT-22 30 00 – Water Heater

Equipment Identification/Tag: _____

Location: _____

Test Duration

Date: _____ Start Time: _____ End Time _____

Estimated Duration: _____

Cx Provider(s): _____

Applicable Equipment: _____

Objectives

This test is performed to investigate the ability of the water heater to provide hot water to the facility.

Instrumentation

Instrument	Accuracy	Measurement
N/A	N/A	N/A

Stated Sequence

To be defined by A/E and commissioning provider at completion of construction documents.

Sampling Set

All units and all sequences.

Procedure

1. Record hot water temperature set point and verify complies with contract documents.
2. Open a single faucet fed by water heater so as to cause water to flow through the hot water supply lines.
3. Record temperature of water exiting water heater.
4. Allow unit to cycle on and off a total of three times.
5. Record temperature of water exiting water heater.
6. Verify no discernable difference between initial and final water temperatures is present.
7. Increase water temperature setpoint by 10°F.
8. Allow unit to cycle on and off a total of three times.
9. Open a single faucet fed by water heater so as to cause water to flow through the hot water supply lines.
10. Record temperature of water exiting water heater and verify temperature is within $\pm 2.0^\circ\text{F}$.
11. Return system to normal operating temperatures

Results

Initial temperature set point:

Temperature setpoint complies with contract documents?

Y / N

Exiting water temperature #1:

Exiting water temperature #2:

No discernable difference in exiting water temperatures ($\pm 1.0^\circ\text{F}$) from unit heater under normal operating conditions for single faucet?

Y / N

Raised temperature set point:

Functional Performance Test
22 30 00 – Plumbing Equipment

Exiting water temperature #3:

Exiting water temperature is within $\pm 2.0^{\circ}\text{F}$ of raised temperature setpoint?

Y / N

Conclusion

Acceptable Criteria: Initial hot water temperature setpoint complies with contract documents. No discernable temperature difference of exiting water temperatures observed under normal operating conditions for single faucet. Difference between temperature setting of the water heater and the temperature read by the test instrument is $\pm 2.0^{\circ}\text{F}$ with raised temperature setpoint.

Comments:

Observations:

Final Status: Accepted Not Accepted

Relevant Trend Data

N/A

Witnesses

Name

Signature

<hr/>	<hr/>
<hr/>	<hr/>
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SECTION 22 11 00
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
1. Scope
 2. Reference
 3. Reference Standards
 4. Shop Drawings
 5. Quality Assurance
 6. Delivery, Storage, and Handling
 7. Design Criteria
 8. Welder Qualifications
- C. PART 2 - PRODUCTS
1. Domestic Water
 2. Dielectric Unions and Flanges
 3. Unions and Flanges
 4. Mechanical Grooved Pipe Connections
- D. PART 3 – EXECUTION
1. General
 2. Preparation
 3. Erection
 4. Copper Pipe Joints
 5. Welded Pipe Joints
 6. Threaded Pipe Joints
 7. Mechanical Grooved Pipe Connections
 8. Domestic Water
 9. Flushing and Disinfection of Potable Water Systems
 10. Dielectric Unions and Flanges
 11. Unions and Flanges
 12. Piping System Leak Tests
 13. Construction Verification Items

1.2 RELATED WORK

- A. Section 01 91 01 – Commissioning Process
- B. Section 22 08 00 – Commissioning of Plumbing
- C. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- D. Section 22 05 14 - Plumbing Specialties

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ANSI A21.4
- B. ANSI A21.11
- C. ANSI A21.51
- D. ANSI B16.5 Pipe Flanges and Flanged Fittings
- E. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- F. ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
- G. ASTM B32 Solder Metal
- H. ASTM B88 Seamless Copper Water Tube
- I. ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

1 **1.5 SHOP DRAWINGS**

- 2 A. Schedule from the contractor indicating the ASTM, AWWA or CISPI specification number of the pipe being
3 proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate
4 the type and rating of fittings for each service.
5 B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA or CISPI specification
6 contained in this section.

7 **1.6 QUALITY ASSURANCE**

- 8 A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
9 B. Order all copper and steel, pipe with each length marked with the name or trademark of the manufacturer and
10 type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper,
11 size, and name of supplier.
12 C. Any installed material not meeting the specification requirements must be replaced with material that meets
13 these specifications without additional cost to the State.

14 **1.7 DELIVERY, STORAGE, AND HANDLING**

- 15 A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
16 B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do
17 not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end
18 caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions
19 by storage inside or by durable, waterproof, above ground packaging.
20 C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
21 D. Storage and protection methods must allow inspection to verify products.

22 **1.8 DESIGN CRITERIA**

- 23 A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, and AWWA
24 specifications as listed in this specification.
25 B. Construct all piping for the highest pressures and temperatures in the respective system.
26 C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation
27 plenum spaces, including plenum ceilings unless approved for this use.
28 D. Where weld fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
29 E. Where ASTM A53 type F pipe is specified, grade A Type E or S, or grade B Type E or S may be substituted at
30 Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially
31 available.
32 F. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper
33 tubing may be substituted at Contractor's option.

34 **1.9 WELDER QUALIFICATIONS**

- 35 A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with
36 certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9
37 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing.
38 Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification
39 together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services
40 Piping.
41 B. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's
42 expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further
43 welding on the project and all defective welds replaced.

44 **PART 2 - PRODUCTS**

45 **2.1 DOMESTIC WATER**

- 46 A. Above Ground:
47 1. Type L copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22;
48 lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.
49 Copper mechanical grooved fittings and couplings on roll grooved pipe may be used in lieu of soldered
50 fittings. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for branch
51 takeoffs up to one-half (1/2) the diameter of the main.

- 1 2. Stainless Steel pipe, all sizes: ASTM A312, Type 304, Schedule 10 or 40 pipe, dimensions conforming to
2 ANSI/ASME B36.19M with threaded, welded or grooved joints. Systems used for potable water to include
3 ANSI/NSF 61 lead free certification. Fittings: ASTM A276 and A312 outlets and austenitic stainless steel
4 plain, threaded or grooved ends, Type 304 or 316. Grooved couplings may be standard painted ductile iron,
5 with EPDM gaskets. 1 1/2" and larger: ASTM A312, Type 304/304L Schedule 10 stainless steel pipe, welded
6 or roll grooved connections. Galvanic corrosion protection required when connecting to copper systems in
7 accordance with manufacturer recommendation. Schedule 10 pipe threaded joints and cut grooved joints
8 are not permitted. Schedule 5 pipe and mechanical press-fit joints are not permitted.
9 B. Below Ground 2-1/2" and Smaller:
10 1. Type K copper water tube, O (annealed) temper, ASTM B88; with cast copper pressure fittings, ANSI B16.18;
11 wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; or cast
12 copper flared pressure fittings, ANSI B16.26.
13 C. THRUST RESTRAINTS FOR UNDERGROUND PIPING:
14 1. Asphaltic or epoxy coated ductile iron follower gland mechanical joint restraint with gripping wedge
15 restraints and torque limiting twist-off nuts around the pipe circumference, low alloy steel T-bolts and UL
16 listing or Factory Mutual approval. For PVC pipe joint bells, use epoxy or primer coated ductile iron bell and
17 serrated ring restraints or gripping wedge restraints and torque limiting twist-off nuts around the pipe
18 circumference with low alloy steel tie bolts. Restraint to have minimum pressure rating and safety factor
19 equal to or greater than pressure rating and safety factor of pipe and be designed specifically for the pipe
20 material it's applied on.

21 **2.2 DIELECTRIC UNIONS AND FLANGES**

- 22 A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2" and smaller; dielectric
23 flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end
24 connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180 degrees.

25 **2.3 UNIONS AND FLANGES**

- 26 A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket
27 material for flanges and flanged fittings shall be teflon type. Treated paper gaskets are not acceptable.
28 B. 2" AND SMALLER STEEL:
29 1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use galvanized malleable iron on galvanized
30 steel piping. Use stainless steel unions for stainless steel piping.
31 C. 2" and Smaller Copper:
32 1. ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
33 D. 2-1/2" and Larger Steel:
34 1. ASTM A181 or A105, threaded only on galvanized steel. Use raised face flanges ANSI B16.5 for mating with
35 other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges
36 with full face teflon gaskets for mating with other flat face flanges on equipment. Gaskets shall be teflon
37 type.
38 E. 2-1/2" and Larger Copper:
39 1. ANSI B15.24 Class 150 cast bronze flanges with full face teflon gaskets.

40 **2.4 MECHANICAL GROOVED PIPE CONNECTIONS**

- 41 A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Gruvlok or Grinnell
42 may be used with cut groove galvanized steel pipe, cut groove ductile iron pipe or roll groove copper pipe where
43 noted. Mechanical grooved components and assemblies to be rated for minimum 250 psi working pressure.
44 B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters to be from the
45 same manufacturer.
46 C. Couplings to be malleable iron, ASTM A47, or ductile iron ASTM A536 with painted finish. Reducing couplings are
47 not acceptable.
48 D. Fittings used on galvanized steel pipe to be malleable iron, ASTM A47, or ductile iron A536, with galvanized finish,
49 ASTM A153. Fittings used on ductile iron pipe to be cement mortar lined ductile iron with coal tar coating, ASTM
50 A536; conforming to requirements of AWWA C110/C153 and AWWA C606. Fittings used on copper pipe to be
51 copper.
52 E. Gaskets to be EPDM, ASTM D2000. Gaskets for hot water systems and dry pipe systems to be flush seal design.
53 Heat treated carbon steel oval neck track bolts and nuts, ASTM A183, with zinc electroplated finish ASTM B633.

- 1 F. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded
2 flanges shall be used.
- 3 G. Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints or
4 flexible connectors may be allowed upon specific application by the Contractor. Three flexible couplings at first
5 three connection points both upstream and downstream of pumps may be used in lieu of flexible connectors.
6 Request for expansion joints shall be made in writing and shall include service, location, line size, proposed
7 application and supporting calculations for the intended service.

8 **PART 3 - EXECUTION**

9 **3.1 GENERAL**

- 10 A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized
11 industry practices.

12 **3.2 PREPARATION**

- 13 A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each
14 section of pipe and fitting prior to assembly.

15 **3.3 ERECTION**

- 16 A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a
17 window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as
18 required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and
19 equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe
20 spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- 21 B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of
22 elastomeric pipe insulation.
- 23 C. Maintain piping in clean condition internally during construction.
- 24 D. Provide clearance for installation of insulation, access to valves and piping specialties.
- 25 E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract
26 without damage to itself, equipment, or building.
- 27 F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including
28 the required service space for this equipment, unless the piping is serving this equipment
- 29 G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide
30 access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems
31 installed by others where same requires the piping services indicated in this section.

32 **3.4 COPPER PIPE JOINTS**

- 33 A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean
34 fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply
35 flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove
36 flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and
37 flux from joint.

38 **3.5 THREADED PIPE JOINTS**

- 39 A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be
40 allowed.

41 **3.6 MECHANICAL GROOVED PIPE CONNECTIONS**

- 42 A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in
43 accordance with the same specifications using specially designed tools specially designed for the application.
44 Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's
45 specifications.

46 **3.7 DOMESTIC WATER**

- 47 A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as
48 work progresses. Cap open pipe ends where left unattended or subject to contamination.

- 1 B. Install interior water piping with drain valves where indicated and at low points of system to allow complete
 2 drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system
 3 for repair. Do not install water piping within exterior walls.

4 **3.8 FLUSHING AND DISINFECTION OF POTABLE WATER SYSTEMS**

- 5 A. Prior to use, isolate and fill system with potable water. Allow to stand 24 hours. Flush each outlet proceeding from
 6 the service entrance to the furthest outlet for minimum of 1 minute and until water appears clear. Fill system with
 7 a solution of water and chlorine containing at least 10 parts per million of chlorine and allow to stand for 24
 8 hours. Flush system with potable water until chlorine concentration is no higher than source water level.
 9 B. Wait 24 hours after final flushing. Take samples of water for lab testing. The number and location of samples shall
 10 be representative of the system size and configuration and are subject to approval by Engineer. Test shall show
 11 the absence of coliform bacteria. If test fails, repeat disinfection and testing procedures until no coliform bacteria
 12 are detected. Submit test report indicating date and time of test along with test results.
 13 C. Piping that is pressure tested shall be drained completely dry. The piping system is not to be left full of stagnant
 14 water. The piping system, water heaters and water softeners shall not be filled until within 10 days of occupancy
 15 to guard against microbial growth.

16 **3.9 DIELECTRIC UNIONS AND FLANGES**

- 17 A. Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic
 18 water systems.

19 **3.10 UNIONS AND FLANGES**

- 20 A. Install a union or flange at each connection to each piece of equipment and at other items which may require
 21 removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the
 22 flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

23 **3.11 PIPING SYSTEM LEAK TESTS**

- 24 A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire
 25 system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully
 26 tested.
 27 B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
 28 Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be
 29 exposed to isolate potential leaks.
 30 C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or
 31 loosening of flanges/unions. Measure and record test pressure at the high point in the system.
 32 D. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will
 33 not be acceptable.
 34 E. Entire test must be witnessed by the Division's representative. All pressure tests are to be documented.

System	Test	Initial Test		Final Test	
	Medium	Pressure	Duration	Pressure	Duration
*Below Ground Domestic	Water	Water	N/A	200 psig	2 hr
Above Ground Domestic	Water	Water	N/A	100 psig	8 hr
Above Ground Non-potable	Water	Water	N/A	100 psig	8 hr
Below Ground Non-potable	Water	Water	N/A	100 psig	8 hr

43 * Leakage on exterior mains 3" and larger may not exceed leakage calculated as follows:

44
$$\text{GPH Allowable Leakage} = \frac{(\text{Feet of Pipe}) (\text{Inches Dia. of Pipe}) (\text{Test Pressure}) \cdot 5}{133,200}$$

46 **3.12 CONSTRUCTION VERIFICATION ITEMS**

- 47 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
 48 22 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

49 **END OF SECTION**

50
 51
 52

1 **PIPING SYSTEM TEST REPORT**

2
3 **Date Submitted:** _____

4
5 **Project Name:** _____

6
7 **Location:** _____ **DFD Project No:** _____

8
9 **Contractor:** _____

10
11 Plumbing Fire Sprinkler
12 **Test Medium:** Air Water Other _____

13
14 **Test performed per specification section No.** _____

15
16 **Specified Test Duration** _____ **Hours** **Specified Test Pressure** _____ **PSIG**

17
18 **System Identification:** _____

19 **Describe Location:** _____

20
21
22 *Test Date:* _____
23 *Start Test Time:* _____ *Initial Pressure:* _____ *PSIG*
24
25 *Stop Test Time:* _____ *Final Pressure:* _____ *PSIG*
26

27 *Tested By:* _____ *Witnessed By:* _____

28 *Title:* _____ *Title:* _____

29 *Signed:* _____ *Signed:* _____

30 *Date:* _____ *Date:* _____

31 **Comments:** _____

32 _____

33 _____

34 _____

35 _____

36 _____

37 _____

38

SECTION 22 13 00
FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Reference
 - 3. Reference Standards
 - 4. Shop Drawings
 - 5. Quality Assurance
 - 6. Delivery, Storage, and Handling
 - 7. Design Criteria
 - 8. Welder Qualifications
- C. PART 2 - PRODUCTS
 - 1. Sanitary Waste and Vent
- D. PART 3 - EXECUTION
 - 1. General
 - 2. Preparation
 - 3. Erection
 - 4. Copper Pipe Joints
 - 5. Threaded Pipe Joints
 - 6. Solvent Welded Pipe Joints
 - 7. Mechanical Hubless Pipe Connections
 - 8. Sanitary Waste and Vent
 - 9. Piping System Leak Tests
 - 10. Construction Verification Items

1.2 RELATED WORK

- A. Section 01 91 01– Commissioning Process
- B. Section 22 08 00 – Commissioning of Plumbing
- C. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- D. Section 22 05 14 - Plumbing Specialties

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ANSI A21.4
- B. ANSI A21.11
- C. ANSI A21.51
- D. ANSI B16.3 Malleable Iron Threaded Fittings
- E. ANSI B16.4 Cast Iron Threaded Fittings
- F. ANSI B16.5 Pipe Flanges and Flanged Fittings
- G. ASTM A74 Cast Iron Soil Pipe and Fittings
- H. ASTM A105 Forgings, Carbon Steel, for Piping Components
- I. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
- J. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- K. ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- L. ASTM C564 Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- M. ASTM C1540 Standard Specifications for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings

- 1 N. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe
- 2 O. ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- 3 P. ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
- 4 Q. ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- 5 R. ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- 6 S. ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- 7 T. ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
- 8 U. ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- 9 V. ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- 10 W. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- 11 X. ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- 12 Y. ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns
- 13 Z. ASTM F2618 CPVC Pipe and Fittings for Chemical Waste Drainage Systems
- 14 AA. CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping
- 15 Applications
- 16 BB. CISPI 310 Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For Sanitary And
- 17 Storm Drain, Waste And Vent Piping Applications

18 **1.5 SHOP DRAWINGS**

- 19 A. Schedule from the contractor indicating the ASTM, or CISPI specification number of the pipe being proposed along
- 20 with its type and grade if known at the time of submittal, and sufficient information to indicate the type and
- 21 rating of fittings for each service.
- 22 B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, or CISPI specification
- 23 contained in this section.

24 **1.6 QUALITY ASSURANCE**

- 25 A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
- 26 B. Order all cast iron and PVC pipe with each length marked with the name or trademark of the manufacturer and
- 27 type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper,
- 28 size, and name of supplier.
- 29 C. Any installed material not meeting the specification requirements must be replaced with material that meets
- 30 these specifications without additional cost to the State.

31 **1.7 DELIVERY, STORAGE, AND HANDLING**

- 32 A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- 33 B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do
- 34 not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end
- 35 caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions
- 36 by storage inside or by durable, waterproof, above ground packaging.
- 37 C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- 38 D. Storage and protection methods must allow inspection to verify products.

39 **1.8 DESIGN CRITERIA**

- 40 A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, or CISPI
- 41 specifications as listed in this specification.
- 42 B. Construct all piping for the highest pressures and temperatures in the respective system.
- 43 C. Piping that is not in accordance with ASTM E-84/UL723 for flame spread of <25 and smoke development of <50
- 44 shall not be utilized in ventilation plenum spaces, including plenum ceilings.
- 45 D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline
- 46 radius of 1.5 pipe diameters.
- 47 E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at
- 48 Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially
- 49 available.
- 50 F. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper
- 51 tubing may be substituted at Contractor's option.

1 **1.9 WELDER QUALIFICATIONS**

- 2 A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with
3 certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9
4 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing.
5 Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification
6 together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services
7 Piping.
8 B. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's
9 expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further
10 welding on the project and all defective welds replaced.

11 **PART 2 - PRODUCTS**

12 **2.1 SANITARY WASTE AND VENT**

- 13 A. Interior Above Ground:
- 14 1. Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 301, CISPI 310, ASTM A74.
15 Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute or receive
16 prior approval of the Engineer. Cast iron piping and fittings shall be of A B & I Foundry, Charlotte Pipe and
17 Foundry, or Tyler Pipe manufacturers.
- 18 2. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe
19 and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
20 (Vent piping only)
- 21 3. CPVC plastic pipe, Schedule 40, ASTM D1784, Class 23447 Type IV, with drainage pattern fittings per ASTM
22 D3311, Solvent cement joints utilizing one step primerless cement as approved by the manufacturer. All
23 fittings and pipe shall be tested and listed in accordance with CAN/ULC S102.2 and tested in general
24 accordance with ASTM E-84/UL723 for flame spread of <25 and smoke development of <50. CPVC pipe and
25 fittings shall be of Charlotte Chem Drain or Spears Lab Waste manufacturers, or equal. (Vent piping only)
- 26 B. Interior Below Ground:
- 27 1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74, with neoprene rubber
28 compression gaskets, ASTM C564, CISPI 301, and CISPI HSN 85. Pipe and fittings shall be marked with the
29 collective trademark of the Cast Iron Pipe Institute. Cast iron piping and fittings shall be of A B & I Foundry,
30 Charlotte Pipe and Foundry, or Tyler Pipe manufacturers.
- 31 2. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe
32 and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM
33 D2564.
- 34 3. CPVC plastic pipe, Schedule 40, ASTM D1784, Class 23447 Type IV, with drainage pattern fittings per
35 ASTM D3311, Solvent cement joints utilizing one step primerless cement as approved by the manufacturer.
36 All fittings and pipe shall be tested and listed in accordance with CAN/ULC S102.2 tested in general
37 accordance, with ASTM E-84/UL 723 for flame spread of <25 and smoke development of <50. CPVC pipe and
38 fittings shall be of Charlotte Chem Drain or Spears Lab Waste manufacturers, or equal.

39 **PART 3 - EXECUTION**

40 **3.1 GENERAL**

- 41 A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized
42 industry practices.

43 **3.2 PREPARATION**

- 44 A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each
45 section of pipe and fitting prior to assembly.

46 **3.3 ERECTION**

- 47 A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a
48 window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as
49 required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and

- 1 equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe
2 spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- 3 B. Where cast iron piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric
4 pipe insulation.
- 5 C. Maintain piping in clean condition internally during construction.
- 6 D. Provide clearance for installation of insulation, access to valves and piping specialties.
- 7 E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract
8 without damage to itself, equipment, or building.
- 9 F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including
10 the required service space for this equipment, unless the piping is serving this equipment
- 11 G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide
12 access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems
13 installed by others where same requires the piping services indicated in this section.

14 **3.4 THREADED PIPE JOINTS**

- 15 A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be
16 allowed.

17 **3.5 SOLVENT WELDED PIPE JOINTS**

- 18 A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut
19 piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with
20 PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to
21 prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease
22 and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials
23 which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter
24 fittings.
- 25 B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply
26 primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2
27 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check
28 for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to
29 the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert
30 pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion
31 must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint
32 for 30 seconds or until set. Reference manufacturer recommendations for initial set time before handling and for
33 full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual
34 circumstances and when specifically approved by the DFD Project Representative.

35 **3.6 MECHANICAL HUBLESS PIPE CONNECTIONS**

- 36 A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting.
37 Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the
38 clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

39 **3.7 SANITARY WASTE AND VENT**

- 40 A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at
41 indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4" per foot where
42 possible and in no case less than 1/8" per foot for piping 3" and larger.
- 43 B. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of
44 project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to
45 be impeded.

46 **3.8 PIPING SYSTEM LEAK TESTS**

- 47 A. Isolate or remove components from system which are not rated for test pressure. Perform final testing for
48 medical and lab gas with all system components in place. Test piping in sections or entire system as required by
49 sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- 50 B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
51 Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be
52 exposed to isolate potential leaks.

- 1 C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or
- 2 loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- 3 D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then
- 4 increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is
- 5 reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be
- 6 approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
- 7 E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will
- 8 not be acceptable.
- 9 F. Entire test must be witnessed by the City of Madison representative. All pressure tests are to be documented.

	Test	Initial Test		Final Test		
10						
11	System	Medium	Pressure	Duration	Pressure	Duration
12	Sanitary Waste and Vent	Water	N/A		10' water	2 hr

13 **3.9 CONSTRUCTION VERIFICATION ITEMS**

- 14 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
- 15 22 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

16 **END OF SECTION**

17

18

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**SECTION 22 14 00
FACILITY STORM DRAINAGE**

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
1. Scope
 2. Reference
 3. Reference Standards
 4. Shop Drawings
 5. Quality Assurance
 6. Delivery, Storage, and Handling
 7. Design Criteria
 8. Welder Qualifications
- C. PART 2 - PRODUCTS
1. Storm and Clear Water Waste
- D. PART 3 - EXECUTION
1. General
 2. Preparation
 3. Erection
 4. Threaded Pipe Joints
 5. Solvent Welded Pipe Joints
 6. Mechanical Hubless Pipe Connections
 7. Storm and Clearwater Waste and Vent
 8. Piping System Leak Tests
 9. Construction Verification Items

1.2 RELATED WORK

- A. Section 01 91 01 – Commissioning Process
- B. Section 22 08 00 – Commissioning of Plumbing
- C. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- D. Section 22 05 14 - Plumbing Specialties

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ANSI A21.4
- B. ANSI A21.11
- C. ANSI A21.51
- D. ANSI B16.3 Malleable Iron Threaded Fittings
- E. ANSI B16.4 Cast Iron Threaded Fittings
- F. ANSI B16.5 Pipe Flanges and Flanged Fittings
- G. ASTM A74 Cast Iron Soil Pipe and Fittings
- H. ASTM A105 Forgings, Carbon Steel, for Piping Components
- I. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
- J. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- K. ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- L. ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- M. ASTM C154 Heavy Duty Shielded Couplings for Joining Hubless Cast Iron Soil Pipe and Fittings
- N. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe
- O. ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- P. ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

- 1 Q. ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
- 2 R. ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- 3 S. ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- 4 T. ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- 5 U. ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- 6 V. ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- 7 W. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- 8 X. ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- 9 Y. ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns
- 10 Z. ASTM F2618 CPVC Pipe and Fittings for Chemical Waste Drainage Systems
- 11 AA. ASTM F437 Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80
- 12 BB. ASTM F438 Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40
- 13 CC. ASTM F441 Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80
- 14 DD. ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- 15 EE. CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping
- 16 Applications
- 17 FF. CISPI 310 Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For Sanitary And
- 18 Storm Drain, Waste And Vent Piping Applications

19 **1.5 SHOP DRAWINGS**

- 20 A. Schedule from the contractor indicating the ASTM, AWWA or CISPI specification number of the pipe being
- 21 proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate
- 22 the type and rating of fittings for each service.
- 23 B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA or CISPI specification
- 24 contained in this section.

25 **1.6 QUALITY ASSURANCE**

- 26 A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
- 27 B. Order all cast iron, PVC and CPVC pipe with each length marked with the name or trademark of the manufacturer
- 28 and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation,
- 29 temper, size, and name of supplier.
- 30 C. Any installed material not meeting the specification requirements must be replaced with material that meets
- 31 these specifications without additional cost to the State.

32 **1.7 DELIVERY, STORAGE, AND HANDLING**

- 33 A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- 34 B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do
- 35 not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end
- 36 caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions
- 37 by storage inside or by durable, waterproof, above ground packaging.
- 38 C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- 39 D. Storage and protection methods must allow inspection to verify products.

40 **1.8 DESIGN CRITERIA**

- 41 A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, AWWA or CISPI
- 42 specifications as listed in this specification.
- 43 B. Construct all piping for the highest pressures and temperatures in the respective system.
- 44 C. Piping that is not in accordance with ASTM E-84/UL723 for flame spread of <25 and smoke development of <50
- 45 shall not be utilized in ventilation plenum spaces, including plenum ceilings.
- 46 D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline
- 47 radius of 1.5 pipe diameters.
- 48 E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at
- 49 Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially
- 50 available.

1 **1.9 WELDER QUALIFICATIONS**

- 2 A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with
3 certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9
4 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing.
5 Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification
6 together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services
7 Piping.
8 B. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's
9 expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further
10 welding on the project and all defective welds replaced.

11 **1.10 PRODUCTS STORM AND CLEARWATER WASTE and VENT**

- 12 A. Interior Above Ground:
- 13 1. Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 301, CISPI 310, ASTM A74.
14 Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute. Cast iron
15 piping and fittings shall be of A B & I Foundry, Charlotte Pipe and Foundry, or Tyler Pipe manufacturers.
- 16 2. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe
17 and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
18 (Vent piping only)
- 19 3. CPVC plastic pipe, Schedule 40, ASTM D1784, Class 23447 Type IV, with drainage pattern fittings per ASTM
20 D3311, Solvent cement joints utilizing one step primerless cement as approved by the manufacturer. All
21 fittings and pipe shall be tested and listed in accordance with CAN/ULC S102.2 and tested in general
22 accordance with ASTM E-84/UL723 for flame spread of <25 and smoke development of <50. CPVC pipe and
23 fittings shall be of Charlotte Chem Drain or Spears Lab Waste manufacturers, or equal. (Vent piping only)
- 24 B. Interior Below Ground 15" and Smaller:
- 25 1. Cast iron soil pipe and fittings, hub and spigot, service weight, CISPI 301, ASTM A74; ASTM A888 with
26 neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with
27 the collective trademark of the Cast Iron Pipe Institute. Cast iron piping and fittings shall be of A B & I
28 Foundry, Charlotte Pipe and Foundry, or Tyler Pipe manufacturers.
- 29 2. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe
30 and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- 31 3. CPVC plastic pipe, Schedule 40, ASTM D 1784, Class 23447 Type IV, with drainage pattern fittings per ASTM
32 D3311, Solvent cement joints utilizing one step primerless cement as approved by the manufacturer. All
33 fittings and pipe shall be tested and listed in accordance with CAN/ULC S102.2 and tested in general
34 accordance with ASTM E-84/UL 723 for flame spread of <25 and smoke development of <50. CPVC pipe and
35 fittings shall be of Charlotte Chem Drain or Spears Lab Waste manufacturers, or equal.

36 **PART 2 - EXECUTION**

37 **2.1 GENERAL**

- 38 A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized
39 industry practices.

40 **2.2 PREPARATION**

- 41 A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each
42 section of pipe and fitting prior to assembly.

43 **2.3 ERECTION**

- 44 A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a
45 window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as
46 required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and
47 equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe
48 spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- 49 B. Where cast iron piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric
50 pipe insulation.
- 51 C. Maintain piping in clean condition internally during construction.
- 52 D. Provide clearance for installation of insulation, access to valves and piping specialties.

- 1 E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract
2 without damage to itself, equipment, or building.
3 F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including
4 the required service space for this equipment, unless the piping is serving this equipment
5 G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide
6 access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems
7 installed by others where same requires the piping services indicated in this section.

8 **2.4 THREADED PIPE JOINTS**

- 9 A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be
10 allowed.

11 **2.5 SOLVENT WELDED PIPE JOINTS**

- 12 A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut
13 piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with
14 PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to
15 prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease
16 and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials
17 which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter
18 fittings.
19 B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply
20 primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2
21 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check
22 for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to
23 the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert
24 pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion
25 must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint
26 for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for
27 full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual
28 circumstances and when specifically approved by the **DFD** Project Representative.

29 **2.6 MECHANICAL HUBLESS PIPE CONNECTIONS**

- 30 A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting.
31 Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the
32 clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

33 **2.7 STORM AND CLEARWATER WASTE and VENT**

- 34 A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at
35 indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/8" per foot where
36 possible and in no case less than 1/16" per foot for piping 3" and larger.

37 **2.8 PIPING SYSTEM LEAK TESTS**

- 38 A. Isolate or remove components from system which are not rated for test pressure. Perform final testing for
39 medical and lab gas with all system components in place. Test piping in sections or entire system as required by
40 sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
41 B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
42 Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be
43 exposed to isolate potential leaks.
44 C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or
45 loosening of flanges/unions. Measure and record test pressure at the high point in the system.
46 D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then
47 increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is
48 reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be
49 approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
50 E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will
51 not be acceptable.
52 F. Entire test must be witnessed by the Division's representative. All pressure tests are to be documented.

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2		Test	<u>Initial Test</u>		<u>Final Test</u>	
3	System	Medium	Pressure	Duration	Pressure	Duration
4	Clearwater Waste and Vent	Water	N/A		10' water	2 hr
5	Storm and Clearwater Waste	Water	N/A		10' water	2 hr

- 6 **2.9 CONSTRUCTION VERIFICATION ITEMS**
- 7 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
- 8 22 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

9 **END OF SECTION**

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SECTION 22 15 13
GENERAL SERVICE COMPRESSED-AIR PIPING

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PART 1 - GENERAL

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1.1 SCOPE

- A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
1. Scope
 2. Reference
 3. Reference Standards
 4. Shop Drawings
 5. Quality Assurance
 6. Delivery, Storage, and Handling
 7. Design Criteria
 8. Welder Qualifications
- C. PART 2 - PRODUCTS
1. Compressed Air
- D. PART 3 - EXECUTION
1. General
 2. Preparation
 3. Erection
 4. Welded Pipe Joints
 5. Threaded Pipe Joints
 6. Compressed Air
 7. Piping System Leak Tests
 8. Construction Verification Items

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1.2 RELATED WORK

- A. Section 01 91 01 – Commissioning Process
- B. Section 22 08 00 – Commissioning of Plumbing
- C. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
- D. Section 22 05 14 - Plumbing Specialties

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1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

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1.4 REFERENCE STANDARDS

- A. ANSI A21.4
- B. ANSI A21.11
- C. ANSI A21.51
- D. ANSI B16.3 Malleable Iron Threaded Fittings
- E. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- F. ASTM A105 Forgings, Carbon Steel, for Piping Components
- G. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

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1.5 SHOP DRAWINGS

- A. Schedule from the contractor indicating the ASTM specification number of the pipe being proposed along with its type and grade, if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA or CISPI specification contained in this section.

1 **1.6 QUALITY ASSURANCE**

- 2 A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
3 B. Order all steel pipe with each length marked with the name or trademark of the manufacturer and type of pipe;
4 with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and
5 name of supplier.
6 C. Any installed material not meeting the specification requirements must be replaced with material that meets
7 these specifications without additional cost to the State.

8 **1.7 DELIVERY, STORAGE, AND HANDLING**

- 9 A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
10 B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do
11 not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end
12 caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions
13 by storage inside or by durable, waterproof, above ground packaging.
14 C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
15 D. Storage and protection methods must allow inspection to verify products.

16 **1.8 DESIGN CRITERIA**

- 17 A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as
18 listed in this specification.
19 B. Construct all piping for the highest pressures and temperatures in the respective system.
20 C. Where weld fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
21 D. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at
22 Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially
23 available.

24 **1.9 WELDER QUALIFICATIONS**

- 25 A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with
26 certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9
27 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing.
28 Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification
29 together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services
30 Piping.
31 B. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's
32 expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further
33 welding on the project and all defective welds replaced.

34 **PART 2 - PRODUCTS**

35 **2.1 COMPRESSED AIR (NON-MEDICAL, NON-LAB)**

- 36 A. 2" and Smaller TOOL AIR:
37 1. Black steel pipe, Schedule 40, Type F, Grade A, ASTM A53; with black malleable iron threaded fittings, Class
38 150, ASTM A197/ANSI B16.3; seamless carbon steel weld fittings, standard weight, ASTM A234 grade
39 WPB/ANSI B16.9.
40 B. 2-1/2" and Larger TOOL AIR:
41 1. Black steel pipe, Schedule 40, type F, Grade A, ASTM A53; with seamless carbon steel weld fittings, ASTM
42 A234 grade WPB/ANSI B16.9.

43 **PART 3 - EXECUTION**

44 **3.1 GENERAL**

- 45 A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized
46 industry practices.

1 **3.2 PREPARATION**
 2 A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each
 3 section of pipe and fitting prior to assembly.

4 **3.3 ERECTION**
 5 A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a
 6 window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as
 7 required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and
 8 equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe
 9 spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
 10 B. Where steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe
 11 insulation.
 12 C. Maintain piping in clean condition internally during construction.
 13 D. Provide clearance for installation of insulation, access to valves and piping specialties.
 14 E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract
 15 without damage to itself, equipment, or building.
 16 F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including
 17 the required service space for this equipment, unless the piping is serving this equipment
 18 G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide
 19 access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems
 20 installed by others where same requires the piping services indicated in this section.

21 **3.4 THREADED PIPE JOINTS**
 22 A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be
 23 allowed.

24 **3.5 COMPRESSED AIR**
 25 A. Install a 4" minimum depth dirt leg at the bottom of each vertical run and at each outlet connection with shutoff
 26 valve at bottom of dirt leg.

27 **3.6 PIPING SYSTEM LEAK TESTS**
 28 A. Isolate or remove components from system which are not rated for test pressure. Perform final testing for
 29 medical and lab gas with all system components in place. Test piping in sections or entire system as required by
 30 sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
 31 B. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then
 32 increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is
 33 reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be
 34 approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
 35 C. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will
 36 not be acceptable.
 37 D. Entire test must be witnessed by the Division's representative. All pressure tests are to be documented.

	Test	Initial Test	Final Test
System	Medium	Pressure	Pressure
Compressed Air	Air	N/A	200 psig
		Duration	Duration
			24 hr

41 **3.7 CONSTRUCTION VERIFICATION ITEMS**
 42 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
 43 22 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

44 **END OF SECTION**
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SECTION 22 16 13
LUBE SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes furnishing and installing all lube systems, equipment and components for a complete installation including:
1. Pipe and pipe fittings.
 2. Valves.
 3. Hose reels.
 4. Air reels.
 5. 55 gallon barrels.
 6. Pallet style containment for barrels.
 7. Bulk Pumps.
 8. Dispensers and meters.
 9. Accessories.
 10. Waste oil and antifreeze storage tanks with self-containment.
 11. Storage cubes with stands.
- B. Lube system components are provided at the service bay (fueling/wash/vac bay) at the bus storage building and at the maintenance building service bays.
- C. Section also includes any brackets, Uni-strut or fasteners as needed in order to mount reels to the steel components (which are supplied under another section in division 5).
- D. Storage tanks provided under this section include drum type, double-wall steel (capable of retaining any leaks without a need for secondary spill protection) and plastic totes, depending on fluid: see section 2. Spill protection for units without integral double wall protection are to include pallet style containment modular units for placement under the actual containers.
- E. Refer to the drawings for locations and quantities of the equipment and components included in this section.
- F. Refer to other sections for air and electrical connections and coordinate with same contractors.
- G. All piping shall be laid out and installed so that there is no interference with such items as cranes (and associated clearance for material handling underneath the entire crane), vehicle movement, platforms and components with other systems provided in other sections.
- H. In mounting reels for fluids specified in this section, allow space on the steel brackets for the installation of reels for water and air, and future reels, as applicable.

1.2 REFERENCES

- A. ANSI B, all sections.
- B. ASTM A53 – Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- C. ASTM A120 – Pipe, Steel, Black, and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- D. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- E. ASTM B88 – Seamless Copper Water Tube.
- F. NFPA 30 – Flammable and Combustible Liquids Code.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate tanks, system layout, pipe sizes, location, and elevations. Show any and all installation details and connections as required for a complete installation.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturer's catalog information. Indicate valve data and ratings. Submit manufacturer's specifications and installation instructions for each type of lubrication equipment, including data indicating compliance with specified requirements.

1.4 PROJECT RECORD DOCUMENTS

- A. Standard manufacturer's warranties.
- B. Record actual location of piping system and system components.

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2 **1.5 OPERATION AND MAINTENANCE DATA**
3 A. Submit under provisions of Division 1.
4 B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views. Provide address
5 and telephone number of nearest authorized service representative.
6
7 **1.6 QUALITY ASSURANCE**
8 A. Valves: Manufacturer's name and pressure rating marked on valve body.
9 B. Welding Materials and Procedures: Conform to ASME Code.
10 C. Welders Certification: In accordance with ASME Sec 9.
11 D. Installer's Certification: In accordance with state regulations.
12 E. Maintain one copy of each document on site.
13
14 **1.7 QUALIFICATIONS**
15 A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum of five
16 years of experience. Provide lubrication equipment as complete systems produced by a single manufacturer,
17 including necessary accessories, fittings and anchorages.
18 B. Installer: Company specializing in performing the work of this section with a Wisconsin certification
19 number for the installer and for the company.
20
21 **1.8 REGULATORY REQUIREMENTS**
22 A. Conform to applicable EPA Regulations for installation of fuel oil system.
23
24 **1.9 DELIVERY, STORAGE, AND HANDLING**
25 A. Deliver, store, protect and handle products to site under provisions of Division 1.
26 B. Provide temporary end caps and closures on piping and fittings. Maintain in-place until installation.
27
28 **PART 2 PRODUCTS**
29
30 **2.1 MATERIALS**
31 A. Contractor shall coordinate with the owner and equipment supplier to provide a complete system that is
32 compatible with the various container sizes and products to be dispensed. Material and equipment shall
33 include all products specified in Part 2 Products.
34
35 **2.2 ANTI-FREEZE FLUID PIPING – ABOVE FLOOR**
36 A. Copper Tubing: ASTM B88, Type K, hard drawn.
37 1. Fittings: ASME B16.18, cast bronze of ASTM B16.22 wrought copper and bronze.
38 2. Joints: NFPA 30; AWS A5.8, BCuP silver braze.
39 B. Steel Pipe: ASTM A53 or A120, or ASME B36.10, Schedule 40 black.
40 1. Fittings: ASTM B16.3, malleable iron, or ASTM A234, forged steel welding type.
41 2. Joints: NFPA 30 threaded or welded to ANSI B31.9.
42
43 **2.3 OIL, TRANSMISSION FLUID AND HYDRAULIC FLUID PIPING – ABOVE FLOOR**
44 A. Steel Pipe: ASTM A179 welded steel tube, 1 inch diameter with .049 thick walls.
45 B. Fittings: Tube compression fitting in steel as manufactured by Parker Ferulok.
46
47 **2.4 VENT LINES FOR BULK LUBE STORAGE TANKS**
48 A. Steel Pipe: ASTM A53 Grade B or ASTM-A-106 Grade B Schedule 80 black.
49 1. Fittings: ASTM B163 malleable iron class 250 or ASTM A234 forged steel welding type. Class 300.
50 2. Joints: Threaded or ANSI D1.1 welded.
51
52 **2.5 FLANGES, UNIONS, AND COUPLINGS**
53 A. Pipe Size 2 Inches and Under:
54 1. Ferrous pipe: 250 psig malleable iron threaded unions.
55 2. Copper tube: 250 psig bronze unions with razed joints.

- 1 B. Pipe Size Over 2 Inches:
- 2 1. Ferrous pipe: 250 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
- 3 2. Copper tube: 250 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.
- 4 C. Dielectric Connections Union with galvanized or plated steel threaded end, copper solder end, water impervious
- 5 isolation barrier.
- 6

7 **2.6 ACCEPTABLE MANUFACTURERS – BALL VALVES**

- 8 A. Nibco T – 585 - 70.
- 9 B. Watts B – 6080
- 10 C. Apollo (Conbraco) #70/77/80/82
- 11 D. Milwaukee BA125
- 12 E. Approved equal.
- 13

14 **2.7 BALL VALVES – FULL PORT TYPE**

- 15 A. Up to 3 Inches Full Port – 2 piece: Bronze body, stainless steel ball, Teflon seats and stuffing box ring, lever
- 16 handle, solder or threaded ends with union.
- 17

18 **2.8 HOSE REELS**

- 19 A. Graco or Samson.
- 20 B. Medium-pressure ½" x 50', A/W, oil and other fluids listed below
- 21 C. Medium pressure ½" x 100' – (HR -1) water.
- 22 D. Medium pressure 1 ½" x 50' – (HR-2) water.
- 23

24 **2.9 PUMPS AND PUMP PACKAGES**

- 25 A. Graco only: universal pump
- 26

27 **2.10 FILTER, REGULATOR, LUBRICATOR (FRL) ASSEMBLIES**

- 28 A. 217072 ½" npt (f) FRL assembly complete with air filter, air regulator, air lubricator, pressure gauge, and
- 29 mounting bracket.
- 30 B. 110225 ½" npt (f) 250 psi (17 bar) bleed-type air shut-off valve.
- 31

32 **2.11 WALL AND FLOOR MOUNTING**

- 33 A. Provide mounting brackets, with type for use at locations shown on the drawings.
- 34

35 **2.12 FLUID SHUT-OFF VALVES**

- 36 A. 108458 ½" npt (f) 2000 psi (140 bar) fluid shut-off valve.
- 37 B. 202869 ½" npt (f) 5000 psi (345 bar) fluid needle valve.
- 38 C. 246637 Wall mount bracket for Diaphragm Pumps.
- 39 D. 237893 Fireball 300 5:1 thermal relief valve.
- 40

41 **2.13 WASTE OIL PUMP**

- 42 A. As applicable provide:
- 43 1. Graco only, with in-line filter.
- 44 2. Filter shall be high-pressure type (7500 psi max) to remove particles from lube lines with replaceable filter.
- 45 Unit is installed prior to pump.
- 46 3. After bidding, contractor may offer integral filter / dispenser unit as an option.
- 47

48 **2.14 DISPENSE VALVES**

- 49 A. Graco SDP electronic meter (to work with Owner's network) with ½" NPT, swivel, rigid extension and standard non-
- 50 drip.
- 51 B. Approved equal.
- 52

53 **2.15 STORAGE SYSTEMS FOR FLUIDS**

- 54 A. AST or Lube Cube Waste Oil Tank and Waste Coolant tanks, 300 gallon double wall tank, total of one each. (owner
- 55 may consider fiberglass units.)
- B. 55 gallon tanks for fluids indicated below at all locations both buildings except as shown otherwise.
- C. Plastic tote for antifreeze, both buildings.

- 1 D. Storage unit for Simple Green: Hastings 300 Self-closing storage tank T-0300-059, including stands, total of 2.
- 2 E. Spill containment: 2 drum capacity, modular, 2-piece, high-density poly units with feature for lifting unit with fork lift:
- 3 Global Industries or approved equal. Provide a total of 8 units.
- 4 F. Painting: All steel tanks and related equipment shall include factory finish paint in high gloss enamel with primer
- 5 coat, or equivalent, where applicable.
- 6

7 **2.16 PUMPS**

- 8 A. Fluid Transfer Pumps
 - 9 1. Graco 10:1 Pump Package / Kit, tank mounted with accessories for waste oil tank.
 - 10 2. Graco 10:1 Package / Kit for attachment to barrels.
 - 11 3. Provide air attachment, overfill alarm, extensions, suction tube and accessories for a complete installation.
- 12 B. Anti-Freeze Pump
 - 13 1. Graco Diaphragm Pump Package.
 - 14 2. Air Regulator.
 - 15 3. Air and Fluid connection hoses.
 - 16 4. Air shut-off valve, wall mount bracket, suction kit, thermal relief kit
- 17 C. Waste Oil
 - 18 1. Graco Diaphragm Pump.
 - 19 2. Wall bracket.
 - 20 3. Air Installation Kit.
 - 21 4. Fluid Installation Kit.
 - 22 5. Drum Style Adapter Kit.
 - 23 6. Overfill Alarm.

24 **2.17 DISPENSERS AND METERS**

- 25 A. Dispensers: Graco SDP series electronic with flexible extension, for oil/antifreeze in sizes and locations as applicable.
- 26 B. Meters: Graco in-line pulse meter (2381618).

27 **2.18 SUMMARY OF FLUIDS AND ACCESSORIES**

- 28 A. The following are fluid containment items using 55 gallon drums, provided in locations as shown on the drawings:
 - 29 1. Washer fluid without meter, all locations shown.
 - 30 2. Coolant for diesel with meter.
 - 31 3. Coolant for E-buses with meter.
 - 32 4. Engine oils with meter.
 - 33 5. ATF for diesel with meter.
 - 34 6. Gear oil for diesel with meter (at maintenance bays only, not at east building).
 - 35 7. DEF with meter.
 - 36 8. Storage unit for Simple Green with fittings (total of 2 with one at each building).
- 37 B. In addition, provide two spare reel units with meters.
- 38 C. Water provided under separate mechanical section.
- 39 D. Meters shall be provided with digital controls to access the owner's network.

40 **PART 3 EXECUTION**

41 **3.01 PREPARATION**

- 42 A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- 43 B. Remove scale and dirt, on inside and outside, before assembly.
- 44 C. Prepare piping connections to equipment with flanges or unions.

45 **3.02 PIPING INSTALLATION**

- 46 A. Install in accordance with manufacturer's instructions and AP1 1615.
- 47 B. Provide non-conducting dielectric connections whenever jointing dissimilar metals. Install to NACE RP- 01-69.
- 48 C. Route piping in orderly manner and maintain gradient.

- 1 D. Install piping to conserve building space and not interfere with use of space.
- 2 E. Group piping whenever practical at common elevations.
- 3 F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- 4 G. Provide clearance for installation of insulation and access to valves and fittings.
- 5 H. Establish elevations of piping inside the building to ensure clearance to vehicles.
- 6 I. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one
- 7 coat of zinc rich primer.
- 8 J. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 1.
- 9 K. Install valves with stems upright or horizontal, not inverted.
- 10 L. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and
- 11 isolating parts of completed system.
- 12 M. Pipes shall run substantially as indicated on the drawings. However, the owner's field representative reserves the
- 13 right to require contractor to make minor changes in pipe locations where conflicts occur with other trades. Such
- 14 changes shall be made without extra cost to owner.
- 15 N. Flexible hoses shall be installed at connection to hose reels.
- 16 O. Flush all lines when piping system has been completed to eliminate any foreign debris prior to introducing project
- 17 into the pipes.
- 18

19 **3.03 APPLICATION**

- 20 A. Install unions downstream of equipment of apparatus connections.
- 21 B. Install gate, ball or butterfly valves for shut-off and to isolate equipment of part of systems.
- 22

23 **3.04 OIL TANK PIPING SYSTEM**

- 24 A. Suction and return lines to be so constructed that there are suitable swing joints near the tank.
- 25 B. Provide new supply and return piping inside the building to all equipment.
- 26 C. The complete oil piping system shall be tested for leaks with not less than 350 lbs. air pressure for a 4-hour period
- 27 before the lines are connected.
- 28
- 29
- 30

END OF SECTION

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1 **SECTION 22 30 00**
2 **PLUMBING EQUIPMENT**

3 **PART 1 - GENERAL**

4 **1.1 SCOPE**

- 5 A. This section includes specifications for water heaters, water softeners, pumps and other equipment used for
6 plumbing applications. Included are the following topics:
7 B. PART 1 - GENERAL
8 1. Scope
9 2. Related Documents
10 3. Reference
11 4. Quality Assurance
12 5. Shop Drawings
13 6. Operation and Maintenance Data
14 C. PART 2 - PRODUCTS
15 1. Water Heaters
16 2. Water Softeners
17 3. Pumps
18 4. Air Compressors and Receivers
19 D. PART 3 - EXECUTION
20 1. Installation
21 2. Construction Verification Items
22 3. Functional Performance Testing
23 4. Agency Training

24 **1.2 RELATED DOCUMENTS**

- 25 A. Section 01 91 01 – Commissioning Process
26 B. Section 22 08 00 – Commissioning of Plumbing
27 C. Section 22 05 23 - General-Duty Valves for Plumbing Piping
28 D. Section 22 05 15 - Piping Specialties
29 E. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment.
30 F. Section 22 07 00 - Plumbing Insulation
31 G. Section 22 15 13 – General Service Compressed Air Piping
32 H. Division 26 00 00 - Electrical

33 **1.3 REFERENCE**

- 34 A. Applicable provisions of Division 1 shall govern work under this section.

35 **1.4 QUALITY ASSURANCE**

- 36 A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Article 7.
37 B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be
38 approved or have pending approval at the time of shop drawing submission.

39 **1.5 SHOP DRAWINGS**

- 40 A. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump
41 curves with net positive suction head requirements, manufacturer's installation requirements, manufacturer's
42 performance limitations, and appropriate identification.

43 **1.6 OPERATION AND MAINTENANCE DATA**

- 44 A. All operations and maintenance data shall comply with the submission and content requirements specified under
45 section GENERAL REQUIREMENTS.

1 **PART 2 - PRODUCTS**

2 **2.1 ELECTRIC AIR HEAT PUMP WATER HEATER**

- 3 A. Manufacturers: A.O. Smith, American, Bradford White, Lochinvar, Rheem, Ruud, State.
4 B. Type: Electric air heat pump storage domestic water heater. Design to be UL listed with 3 year commercial use
5 tank warranty and 1 year parts warranty.
6 C. Efficiency:
7 ≤ 12 kW Minimum Energy Factor = .97- (.00035 x Volume (gal))
8 > 12 kW Standby Loss (%/h) = .3+(27/measured tank volume)
9 D. Tank: Steel glass lined tank rated for 150 psig complete with removable magnesium anode rod, plastic diffuser
10 type dip tube, inlet and outlet heat trap fittings, minimum R-20 polyurethane foam insulation, painted steel
11 jacket, drain valve and temperature and pressure relief valve.
12 E. Elements: Dual long lasting backup heating elements to be replaceable threaded low watt density incoloy sheath
13 with adjustable thermostat control, energy cutoff and wired for non-simultaneous operation.
14 F. Electric Heat Pump

15 **2.2 WATER SOFTENERS**

- 16 A. Manufacturers: Capital, Culligan, Hellenbrand, Kinetico, Water Right.
17 B. Influent
18 Water Analysis: Constituent
19 Hardness 20 grains/gallon
20 pH 7.8
21 Iron .15 mg/l and ppm
22 Manganese 37 mg/l and ppm
23 C. Product
24 D. Standards:
25 1. NSF/ANSI 61 for materials in contact with water.
26 2. NSF/ANSI 44 for residential softeners, control valves 1.25" and smaller, and tank structural.
27 3. NSF/ANSI 372 for lead content of materials in contact with water.
28 E. Fiberglass Ion Exchange Media Tanks: Fiberglass reinforced ion exchange media tank constructed of molded high
29 density polyethylene inner shell reinforced by exterior fiberglass winding and epoxy resin rated for 150 psig at
30 120°F with 5 year warranty. Complete with slotted or hub and lateral distributor tube in washed quartz bed or
31 bottom plate distributor.
32 F. Ion Exchange Media: High capacity cation ion exchange media, minimum of 8% crosslinked media.
33 G. Brine Tank: High density polyethylene salt and brine storage tank with cover, brine well, safety brine valve
34 assembly, air check and overflow fitting. Contractor to provide initial fill with high purity solar or pellet salt
35 recommended by manufacturer.
36 H. Control Valve:
37 1. Top or side-mount glass filled polymer (Noryl™), stainless steel or brass construction with hydraulically
38 balanced piston, seals and spacer. Fully adjustable regeneration cycle durations for backwash, brining/slow
39 rinse, fast rinse, timed brine refill and return to service.
40 I. Microprocessor Controller:
41 1. LED/OLED/LCD display with status for online, regeneration and standby modes; time of day; gallons since
42 last regeneration and gallons remaining; days until regeneration, flow rate and total volume used.
43 Permanent memory backup of programming and battery backup for time of day. Regeneration programming
44 options include variable reserve, fixed reserve, immediate and delayed regeneration, calendar day override,
45 hardness sensor initiated and pressure differential regeneration.
46 2. Electronic Inline Flow Meter: Hall effect sensor. PVC, glass filled polymer, stainless steel, bronze or brass
47 construction. Accurate to +/- 5% of reading over softener flow range.
48 J. Electrical:
49 1. 120 volt AC, DC adapter/transformer for DC powered systems, power cord and plug, factory wired and
50 tested controls.
51 K. Efficiency Rating:

- 1 1. Provide minimum system efficiency of 4,000 grains/lb of salt with a maximum of 10 mg/l of hardness
2 leakage. Demonstrate efficiency through pre-certification by third party testing organization,
3 manufacturer's engineering calculations or field sampling, meter analysis and adjustment.
4 L. Operation:
5 1. Single Tank System – Delayed meter or hardness sensor initiated regeneration, one flow meter, variable
6 reserve with proportional brining
7 M. Accessories:
8 1. Inlet and outlet flexible braided stainless steel pipe connectors where recommended by ion exchange media
9 tank manufacturer, 150 psig at 120°F.
10 2. Inlet and outlet sampling valves, inlet and outlet pressure gauges with shutoff valve for each ion exchange
11 media tank.
12 3. Hach 5B or equal hardness test kit.
13 4. Ion exchange media tank inlet and outlet unions, shutoff and bypass valves.

14 **2.3 IN-LINE CENTRIFUGAL PUMPS**

- 15 A. Manufacturer: Bell and Gossett, Gould, Grundfos, Taco.
16 B. Type: Horizontal single stage oil lubricated in-line pumps, 125 psig maximum working pressure at operating
17 temperature of 225°F continuous. The manufacturer shall certify all pump ratings. All pumps to operate without
18 excessive noise or vibration.
19 C. Casing: Bronze or stainless steel; flanged suction and discharge connection.
20 D. Impeller: Brass or bronze, keyed to the shaft, single suction enclosed type, hydraulically and dynamically
21 balanced.
22 E. Bearings: Oil lubricated bronze sleeve or ball bearings.
23 F. Shaft: Stainless steel or carbon steel with stainless steel or bronze sleeve, integral thrust collar.
24 G. Seal: Mechanical type, carbon rotating against a stationary ceramic seat, 225°F maximum continuous operating
25 temperature.
26 H. Drive: Flexible coupling.
27 I. Motor: Provide pump with open dripproof motor with built-in thermal overload protection sized for non-
28 overloading over the entire pump curve. Furnish each pump and motor with a nameplate giving the
29 manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower,
30 voltage, frequency, speed and full load current.

31 **2.4 AIR COMPRESSORS AND RECEIVERS**

- 32 A. GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS
33 1. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled;
34 continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
35 2. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA
36 ICS 2 and UL 508.
37 a. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
38 b. Motor Controllers: Full-voltage, combination magnetic type with under voltage release feature and
39 motor-circuit-protector-type disconnecting means and short-circuit protective device.
40 c. Control Voltage: 120-V ac or less, using integral control power transformer.
41 d. Motor Overload Protection: Overload relay in each phase.
42 e. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for
43 automatic control.
44 3. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough
45 to resist packaged equipment movement during a seismic event when base is anchored to building
46 structure.
47 B. ROTARY-SCREW AIR COMPRESSORS
48 1. Rotary-Screw Air Compressors:
49 a. Manufacturers: Subject to compliance with requirements, provide products by the following:
50 b. Ingersoll Rand.
51 c. Kaeser.
52 d. Quincy.

- 1 e. PneuTech
2
3 2. Description: Packaged unit.
4 3. Air Compressor(s): Single-stage, oil-free, rotary-screw type with nonlubricated helical screws and lubricated
5 gearbox, and of construction that prohibits oil from entering compression chamber.
6 a. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package pre-piped to unit; with
7 air-pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal-bypass
8 valve.
9 b. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.
10 c. Air/Coolant Receiver and Separation System: 150-psig- (1035-kPa-) rated steel tank with ASME
11 safety valve, coolant-level gage, multistage air coolant separator element, minimum pressure valve,
12 blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal-
13 bypass valve.
14 d. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating
15 pressures between 60 and 135 psig (345 and 690 kPa). Include necessary control to hold constant
16 pressure. When air demand is zero, unload compressor by using pressure switch and blowdown
17 valve.
18 e. Mounting: Freestanding.
19 4. Sound-attenuation enclosure.
20 5. Capacities and Characteristics:
21 a. Compressed-Air Service: Shop air.
22 b. Air Compressor(s): One.
23 c. Standard-Air Capacity of Each Air Compressor: See Schedule
24 d. Actual-Air Capacity of Each Air Compressor: See Schedule
25 e. Discharge-Air Pressure: 135.
26 f. Discharge-Air Temperature: 100° F (deg C) or less.
27 g. Motor (Each Air Compressor):
28 1) Horsepower: See Schedule
29 2) Speed: See Schedule
30 h. Electrical Characteristics:
31 1) Volts: 460.
32 2) Phase(s): Three.
33 3) Hertz: 60.
34 4) Full-Load Amperes: See Schedule
35 5) Maximum Overcurrent Protection: See Schedule
36 C. RECEIVER TANK
37 1. Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
38 a. Orientation: Vertical Arrangement.
39 b. Capacity: See drawing schedule.
40 c. Interior finish: Epoxy.
41 d. Pressure Rating: 165psig minimum.
42 e. Pressure Regulator Setting: 135psig.
43 f. Pressure Relief Valve Setting: 137psig.
44 g. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.
45 D. MOTORS
46 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency
47 requirements for motors specified.
48 a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not
49 require motor to operate in service factor range above 1.0.
50 b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and
51 connections specified in Division 26 Sections.
52 E. EQUIPMENT INSTALLATION
53 1. Equipment Mounting: Install air compressors and air dryers anchored to concrete bases using elastomeric
54 pads. Comply with requirements in Division 03 Section "Cast-in-Place Concrete."
55 2. Arrange equipment so controls and devices are accessible for servicing.
3. Maintain manufacturer's recommended clearances for service and maintenance.

- 1 4. Install the following devices on compressed-air equipment:
2 a. Pressure Gage and Safety Valve: Install on each compressed-air receiver.
3 b. Pressure Regulators: Install downstream from air compressors and dryers.
4 c. Automatic Drain Valves: Install on filters and dryers. Discharge condensate over nearest floor or
5 open site drain.
- 6 F. CONNECTIONS
7 1. Comply with requirements for piping specified in Division 22 Section "Compressed Air Piping." Drawings
8 indicate general arrangement of piping, fittings, and specialties.
9 2. Install piping adjacent to machine to allow service and maintenance.
- 10 G. STARTUP SERVICE
11 1. Perform startup service.
12 a. Complete installation and startup checks according to manufacturer's written instructions.
13 b. Verify that air-compressor inlet filters and piping are clear.
14 c. Check for equipment vibration-control supports and flexible pipe connectors and verify that
15 equipment is properly attached to substrate.
16 d. Check safety valves for correct settings. Ensure that settings are higher than air compressor
17 discharge pressure but not higher than rating of system components.
18 e. Drain receiver tanks.
19 f. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor
20 rotation and unit operation.
21 g. Test and adjust controls and safeties.
- 22 H. DEMONSTRATION
23 1. Train Owner's maintenance personnel to adjust, operate, and maintain air compressors and dryers.

24 **PART 3 - EXECUTION**

25 **3.1 INSTALLATION**

- 26 A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate
27 equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances.
28 Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- 29 B. Set commercial water heaters and commercial water softeners, on concrete housekeeping pads. Adjust and level
30 equipment.
- 31 C. Connect equipment to water and drain piping using unions or flanges and isolation valves. Water softener drain
32 pipe and fittings to be solvent welded PVC/CPVC SDR 13.5. Water softener brine piping to be polyethylene as
33 supplied by softener manufacturer or same as drain piping.
- 34 D. Size temperature and relief valves per CSA ratings. Pipe temperature and pressure relief valves to floor drain or
35 floor as indicated.
- 36 E. Startup and test equipment adjusting operating and safety controls for proper operation.
- 37 F. Water Softener Startup: Do not fill water softeners with water or startup until building occupancy and active use
38 to avoid stagnant conditions and resulting microbiological contamination. Maintain water softeners in dry bypass
39 mode until active use. Program and cycle water softeners for specified minimum efficiency rating, regeneration
40 cycle intervals and times, consumption, backflow rate, brine flow rate, variable reserve and proportional brining,
41 etc. Program standby ion exchange media tanks into service every 12 hours for minimum of 1 tank full of water to
42 pass through. Provide initial salt fill of brine tank. Test and report on untreated and treated water hardness, pH,
43 iron and chlorine. For water softeners demonstrating efficiency through field sampling, meter analysis and
44 adjustment; report field data confirming efficiency.
- 45 G. Lubricate pumps before startup. Adjust pumps for rated flow. Clean and blowdown strainers after 8 hours of
46 operation.

47 **3.2 CONSTRUCTION VERIFICATION ITEMS**

- 48 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
49 22 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

1 **3.3 FUNCTIONAL PERFORMANCE TESTING**

2 A. Contractor is responsible for utilizing the functional performance test forms supplied under specification Section
3 22 08 00 in accordance with the procedures defined for functional performance testing in Section 01 91 01.

4 **3.4 AGENCY TRAINING**

5 A. All training provided for agency shall comply with the format, general content requirements and submission
6 guidelines specified under Section 01 91 01.

7 **END OF SECTION**

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**SECTION 22 42 00
COMMERCIAL PLUMBING FIXTURES**

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PART 1 - GENERAL

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1.1 SCOPE

- A. This section includes specifications for plumbing fixtures, faucets and trim.
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Quality Assurance
 - 4. Shop Drawings
 - 5. Operation and Maintenance Data
 - 6. Design Criteria
 - 7. Energy Efficiency Requirements
- C. PART 2 - PRODUCTS
 - 1. Plumbing Fixtures
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Construction Verification Items

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1.2 RELATED WORK

- A. Section 01 91 01 – Commissioning Process
- B. Section 22 08 00 – Commissioning of Plumbing
- C. Section 22 11 00 - Facility Water Distribution
- D. Section 22 13 00 - Facility Sanitary Sewerage
- E. Section 22 14 00 - Facility Storm Drainage
- F. Section 22 15 13 - General Service Compressed-Air Piping
- G. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
- H. Section 22 05 14 - Plumbing Specialties

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29

1.3 REFERENCE

- A. Applicable provisions of Division 1 shall govern work under this section.

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1.4 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

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1.5 SHOP DRAWINGS

- A. Include data concerning sizes, utility sizes, rough in-dimensions, capacities, materials of construction, ratings, weights, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

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1.6 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

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1.7 DESIGN CRITERIA

- A. ANSI A112.6.1M-88 - Supports for Off-the Floor Plumbing Fixtures for Public Use.
- B. ANSI A112.18.1-94 - Finished and Rough Brass Plumbing Fixture Fittings.
- C. ANSI A112.19.2M-82 - Vitreous China Plumbing Fixtures.
- D. ANSI A112.19.5-79(R1990) - Trim for Water Closet Bowls, Tanks and Urinals.
- E. ARI-1010-94 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.
- F. ASSE 1011-93 - Hose Connection Vacuum Breakers.
- G. ASSE 1014-90 - Handheld Showers.

1 **1.8 ENERGY EFFICIENCY REQUIREMENTS**

- 2 A. Plumbing fixtures must meet the following maximum water usage requirements which are based upon Federal
3 Energy Management Program (FEMP) performance requirements.
4 1. Lavatory Faucets, flow of 2 gpm or less and .25 gallon per cycle or less (based on inlet pressure of 60 p.s.i.)
5 2. Showerheads, flow of 2.2 gpm or less (based on inlet pressure of 80 p.s.i.)
6 3. Urinal Flush Valves, 1.0 gallon per flush or less.
7 4. Water Closet Flush Valves, 1.6 gallon per flush or less.

8 **PART 2 - PRODUCTS**

9 **2.1 PLUMBING FIXTURES**

- 10 A. Manufacturers: Fixture descriptions establish fixture type, quality, materials, features and size. Products of the
11 following manufacturers determined to be equal by the Architect/Engineer will be accepted.
12 1. Water Closets - Kohler.
13 2. Water Closet Seats - Bemis, Beneke, Centoco, Olsonite Sperzel.
14 3. Urinals –Kohler.
15 4. Lavatories –Kohler.
16 5. Faucets - Chicago Faucet, Zurn.
17 6. Drains - Chicago Faucet, Engineered Brass Co., Kohler, McGuire.
18 7. Stops and Supplies - Chicago Faucet Co., McGuire. (Heavy Duty Type Only)
19 8. Flush Valves - Sloan Royal, Zurn AV.
20 9. Traps - Kohler, McGuire, Dearborn, Engineered Brass Co. (17 gauge Min.)
21 10. Carriers and Supports - Josam, Smith, Wade, Watts Drainage, Zurn.
22 11. Washfountains - Acorn, Bradley.
23 12. Sinks - American Standard, Elkay, Just, Kohler.
24 13. Mop Basins - Fiat, Mustee, Stern-Williams.
25 14. Showers - Symmons, Zurn, Chicago Faucet.
26 15. Electric Water Coolers - Elkay, Halsey Taylor, Haws, Filtrine, Oasis, Sunroc.
27 16. Emergency Eyewash Fountains and Showers - Bradley, Chicago Faucet Co., Guardian, Haws, Speakman.

28 **2.2 Water Closets**

- 29 A. WC-1 - Wall hung back outlet white vitreous china siphon jet water closet with elongated bowl, 1-1/2" top spud,
30 2-1/4" passageway and 1.28 gallon flush. Flush valve rough in 11 1/2" above rim.
31 1. Fixture: Kohler Kingston K-4325.
32 2. Flush Valve: Zurn Z6000 AV-HET.
33 3. Seat: Bemis 1655-SS/C white solid plastic open front.
34 4. Carrier: Smith commercial grade adjusted for 15" bowl height.
35 B. WC-2 - Same as WC-1, barrier free adjusted for 16-1/2" bowl height. Operating handle of the flush valve to be
36 ADA compliant for activation force and located to the wide side of the stall. Flush valve rough in 11 1/2" above rim.
37 1. Flush Valve: Zurn Z6000 AV-HET
38 C. WC-3 - Floor mount bottom outlet white vitreous china siphon jet water closet with elongated bowl, 1-1/2" top
39 spud, 2-1/8" passageway, 16-5/8" rim height and 1.28 gallon flush. Flush valve rough in 11 1/2" above rim, located
40 to the wide side of the stall and be ADA compliant for activation force.
41 1. Fixture: Kohler Highcliff Ultra 96057-SS.
42 2. Flush Valve: Zurn Z6000 AV-HET.
43 3. Seat: Bemis 1655-SS/C white solid plastic open front.

44 **2.3 Urinals**

- 45 A. UR-1 - Wall mount white vitreous china washout urinal with 3/4" top inlet spud, 2" outlet, removable strainer.
46 Manual operated flush valve, 1.25 gallon per flush or less. Flush valve handle to be ADA compliant.
47 1. Fixture: Kohler Bardon K-4991-ETSS.
48 2. Flush Valve: Zurn Z6003 AV-ULF.
49 3. Carrier: Smith commercial grade adjusted for 16" lip height.

50 **2.4 Lavatories**

- 51 A. Lavatory faucets must meet maximum water usage requirements of 2 gpm flow or less and .25 gallon per cycle or
52 less (based on inlet pressure of 60 p.s.i.)

- 1 B. L-1 - Wall mount barrier free white vitreous china lavatory drilled for concealed arm carrier with 4" on center
2 faucet openings. Metered faucet with .5 gpm maximum flow rate. Fixture and trim to be ADA compliant.
3 1. Fixture: Kohler Kingston K-2005.
4 2. Faucet: Chicago Faucet No.3502-4E2805ABCP.
5 3. Drain: Kohler K-13885 perforated strainer and 1-1/4" offset tailpiece.
6 4. Trap: 1-1/4"x1-1/2" 17 ga. cast brass trap and tubular wall bend. With C.O. plug.
7 5. Supplies & Stops: Chicago Faucet No. 1017CP.
8 6. Carrier: Smith floor mounted concealed arm adjusted for 34" height.

9 **2.5 Washfountains**

- 10 A. WF-1 - Floor mounted stainless steel 3 station washfountain with stainless steel access panel, floor and bowl
11 anchor brackets, supply stops, strainers, check valves, thermostatic mixing valve, flow restrictors, foot button
12 control, liquid soap dispenser.
13 1. Fixture: Bradley 3543-2-F-DV.
14 2. Trap: 1-1/2" 17 ga. cast brass trap.
15 3. Stops: Ball valves

16 **2.6 Sinks**

- 17 A. S-1 – Under mounted 18 ga. type 304 stainless steel single compartment sink overall 18 1/2" x 18" x 5 3/8". Bowl
18 16" x 16" x 5 3/8". Faucet deck mounted. level handle control 1.5 GPM. Aerator outlet 9 1/2: L-Type spout with
19 garbage disposal.
20 1. Fixture: Elkay ELUHAD 161655
21 2. Faucet: Chicago Faucet No. 201-XKABCP
22 3. Drains: Elkay LK AD35 with offset tailpiece
23 4. Traps: 1-1/2" x 1-1/2" 17 ga. cast brass trap and tubular wall bend. With C.O. plug
24 5. Supplies & Stops: Chicago Faucet No. 1013-CP w/ 3/8" riser. length as necessary
25 B. S-2 -Integral sink by others, ADA compliable with 3 faucet openings 4" on center. Faucet deck mounted. level
26 handle control 1.5 GPM. Aerator outlet 9 1/2: L-Type spout.
27 1. Faucet: Chicago Faucet No. 786 GN8FCJKABCP 369-PRJKCP
28 2. Drains: Elkay LK AD35 with offset tailpiece
29 3. Traps: 1-1/2" x 1-1/2" 17 ga. cast brass trap and tubular wall bend. With C.O. plug
30 4. Supplies & Stops: Chicago Faucet No. 1013-CP w/ 3/8" riser. length as necessary
31 5. Garbage Disposal: Insinkerator evolution excel 1 HP/120/60/1.

32 **2.7 Mop Basins**

- 33 A. MB-1 - Floor mounted molded polyester resin and stone mop basin, 24"x24"x10" H, with 3" drain, stainless steel
34 strainer and vinyl bumper guards.
35 1. Fixture: Fiat MSB-2424.
36 2. Faucet: Chicago Faucet No.897RCF with Watts 8BC vacuum breaker.
37 3. Hose: Fiat 832-AA.
38 4. Stops: (Integral with faucet)

39 **2.8 SHOWERS**

- 40 A. SH-1 - Pressure balanced shower valve. check stops. adjustable temperature limit stop and volume
41 control. Lever handle operated. With lever operated diverter valve. stationary shower head and hand-
42 held adjustable head with 48" slide bar. 60" hose. in-line vacuum breaker and supply elbow ADA
43 compliable. Include shower safing.
44 1. Valve Assembly: Symmons Safetymix 1-117-FS. 1.5-B48-VB-VP-X. (1.5 gpm@ 80 psi)
45 2. Floor Drain: 2" FD- I

46 **2.9 ELECTRIC WATER COOLERS**

- 47 A. EWC-1 - Dual level wall mounted barrier free electric water cooler with stainless steel basins, bottle filler, filtered,
48 self-closing front and side mounted push bars, wall hanger and 1-1/4" tailpiece, rated for 8.0 GPH at 80 degree
49 inlet water, 90 degree ambient and 50 degree leaving water, 3 70 watts, 120/60/1. Light gray side panels. Mount
50 lower station on the right hand side at ADA height. Reverse mounting where required to meet accessibility
51 requirements. Install bottle filler on ADA lower station side.
52 1. Fixture: Elkay LZSTL8WS-LK
53 2. Trap: 1-1/4" x 1-1/4" PVC trap

- 1 3. Stop/Supply: Chicago Faucet Co. 1013-CP or ½" ball valve with 3/8" riser (concealed)
- 2 B. EWC-2 - Single level wall mounted barrier free electric water cooler with stainless steel basin, bottle filler, filtered,
- 3 self-closing front and side mounted push bars, wall hanger and 1-1/4" tailpiece, rated for 8.0 GPH at 80 degree
- 4 inlet water, 90 degree ambient and 50 degree leaving water, 370 watts, 120/60/1. Light gray side panels. Mount
- 5 station at ADA height.
- 6 1. Fixture: Elkay LZS8WSLK
- 7 2. Trap: 1-1/4"x 1-1/4" PVC trap
- 8 3. Stop/Supply: Chicago Faucet Co. 1013-CP or ½" ball valve with 3/8" riser (concealed)

9 **2.10 EMERGENCY EYEWASH FOUNTAINS AND SHOWERS**

- 10 A. EEW-1 - Wall mounted emergency eyewash with plastic bowl, eye and face wash fittings, 1/2" ball valve with push
- 11 flag operator, dome strainer and wall bracket.
- 12 1. Fixture: Bradley S19224 FW.
- 13 2. Trap: 1-1/4"x1-1/4" 17 ga. cast brass trap with tubular wall return.
- 14 3. Mixing Valve: Bradley #19-2000SE with surface mounted with white enameled cabinet.

15 **PART 3 - EXECUTION**

16 **3.1 INSTALLATION**

- 17 A. Install plumbing fixtures in accordance with manufacturers instructions. Set level and plumb. Secure in place to
- 18 counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall.
- 19 Secure rough-in fixture piping to prevent movement of exposed piping.
- 20 B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible
- 21 location for servicing.
- 22 C. Install barrier free fixtures in compliance with IBC 1108 and 3408, COMM 52, 69 and Federal ADA Accessibility
- 23 Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27"
- 24 above floor to avoid contact by wheelchair users.
- 25 D. Provide unions at water connections to drinking fountains and electric water coolers.
- 26 E. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with
- 27 brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.
- 28 F. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated
- 29 brass, same items in concealed locations may be of rough brass finish.
- 30 G. Set floor mounted water closets, counter mounted sinks; lav and sink faucets and drains with full setting bed of
- 31 flexible non-staining plumber's putty. Cover exposed water closet bolts with bolt covers.
- 32 H. Set mop basins and wash fountains to floor and wall with grout or silicone sealant.
- 33 I. Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.
- 34 J. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for
- 35 intended water flow rate to fixtures without splashing, noise or overflow. Adjust self-closing lavatory faucets to 15
- 36 second cycle. Adjust shower valve temperature limit stops to 110 degree maximum outlet temperature.
- 37 K. Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's
- 38 recommended cleaning methods and materials.
- 39 L. Existing Fixtures: Where existing fixtures and fittings are indicated to be reused or relocated, this contractor is
- 40 responsible for documenting condition prior to construction and for damages incurred during construction.

41 **3.2 CONSTRUCTION VERIFICATION ITEMS**

- 42 A. Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
- 43 22 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

44 **END OF SECTION**

**SECTION 23 05 00
HVAC GENERAL PROVISIONS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. HVAC work includes:

1. Furnish all labor and materials necessary for the complete installation of heating, ventilating and air conditioning system as shown on the drawings and/or specified herein.
2. Drawings: Refer to H-Series drawings for graphic representations, schedules and notations showing HVAC work.
3. Specifications: Applicable portions of Division 1 govern all work under this Section. Refer to Division 23 Sections for primary technical specifications of HVAC work, as listed below:

23 05 00	HVAC General Provisions
23 05 90	Testing Adjusting and Balancing
23 06 00	Pipe and Pipe Fittings
23 06 30	Piping Specialties
23 09 10	Supports and Anchors
23 10 00	Valves
23 14 00	Pumps
23 20 00	Vibration Isolation
23 25 00	Mechanical Insulation
23 62 00	Heating Hot Water Boilers
23 63 00	Water Treatment
23 66 00	Air Cooled Condensing Units
23 74 00	Terminal Air Distribution Units
23 74 10	Gas-Fired Heating Units
23 74 20	Gas-Fired Make-Up Air Units
23 76 30	Air Handling Units
23 82 00	Fans
23 82 50	Energy Recovery Units
23 84 00	Ductwork
23 86 00	Ductwork Accessories
23 87 00	Air Inlets and Outlets
23 89 50	Variable Frequency Drives
23 90 00	Controls and Instrumentation
23 91 00	Direct Digital Control Systems
23 95 00	Control Sequences
23 95 10	DDC Point List
23 96 00	Starting of Mechanical Systems

4. Equipment structural supports, prime painted.
5. Motors for all HVAC equipment.
6. Secure and pay all construction permit fees.
7. Test, adjust and balance HVAC systems.
8. Commissioning HVAC systems.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. General Work by HVAC Contractor:
 - 1. Field painting of all exposed piping, ductwork, hangers, supports and related metal work, unless noted specifically in the Drawings or Specifications herein.
 - 2. Building provisions for all recesses and chases intended as equipment space for ductwork and piping in new construction.
 - 3. Lintels and openings for ducts and piping through existing walls, floors and ceilings.
 - 4. Line voltage (greater than 100 volts) wiring, conduit and connections.
 - 5. All equipment starters not furnished as integral part of HVAC equipment.
- D. Coordination of Work:
 - 1. General: Contract Documents are diagrammatic in showing certain physical relationships which must be established within HVAC work, and in its interface with other work including electrical work, and that such establishment is the exclusive responsibility of the Contractor.
 - 2. Arrange HVAC work in neat, well-organized manner with piping and similar services running parallel with primary lines of building construction, and with minimum of 7-foot overhead clearance.
 - 3. Give right-of-way to piping which must slope for drainage.
 - 4. Advise other trades of openings required in their work for subsequent move-in of large units of HVAC work.

1.3 SHOP DRAWINGS AND SAMPLES

- A. The Contractor shall submit to the Architect for approval, shop drawings, giving details, dimensions, capacities, accessories, wiring diagrams, etc., of all materials as indicated in respective specification sections.
- B. All shop drawings shall include proper identification of equipment by name and/or number, as indicated in the specification and/or shown on the plans.
- C. Shop drawings shall be submitted for approval as soon as practicably possible after award of contract. Shop drawings must be approved before installation of materials and equipment. Drawings shall be submitted in accordance with the requirements outlined in Division 1 of the Specifications.
- D. The examination and approval of shop drawings shall not relieve the Contractor from any obligation to perform the work strictly in accordance with the Contract Drawings and Specifications. The responsibility for errors in shop drawings shall remain with the Contractor.
- E. Electronic shop drawing submittals require file labeling to match specification section contained and all equipment identified properly compatible with construction documents. All shop drawings improperly labeled and identified will be returned for corrections.

1.4 QUALITY ASSURANCE

- A. Qualifications of Installers: For the actual fabrication, installation and testing of work under this Section, use only thoroughly trained and experienced workmen completely familiar with the items required and the manufacturer's current recommended methods of installation.
- B. In acceptance or rejection of installed work, the Architect will make no allowance for lack of skill on the part of the workmen.

C. Reference Standards: Specifically, for HVAC work in addition to standards specified in individual work section, the following standards are imposed, as applicable to work in each instance:

AABC	Associated Air Balance Council
ADC	Air Diffusion Council
AGA	American Gas Association
AMCA	Air Movement and Control Association
ANSI	American National Standard Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
IEEE	Institute of Electrical and Electronics Engineers
MICA	Midwest Insulation Contractors Association
MSS	Manufacturer's Standardization Society
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electric Manufacturer's Association
NFPA	National Fire Protection Association
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
UMC	Uniform Mechanical Code
UL	Underwriter's Laboratories

All federal, state, local codes, ordinances and utility regulations.

D. Environmental design conditions for all occupied areas are as follows:

	<u>Winter</u>	<u>Summer</u>
Inside:	70 degrees F	75 deg. F 50% RH
Outside:	-20 degrees F	91 deg. dbF/74 deg. wbF

E. Approval of Materials: Refer to General Conditions, Supplementary General Conditions and other requirements of Division 1 for approval of materials and requirements of substituted equipment.

1.5 JOB CONDITIONS

A. Building Access: Arrange for the necessary openings in the building to allow for admittance of all HVAC equipment.

B. Temporary Services: No service shall be interrupted or changed without the prior approval of the Owner. Refer to Division 1 requirements.

C. Compatibility: Provide products which are compatible with other products of HVAC work, and with other work requiring interface with HVAC work. Provide products with proper or correct power characteristics, fuel-burning characteristics and similar adaptation for Project. Coordinate selections from among options for compatibility of products. Design and layout is based on equipment scheduled on drawings or in specifications.

1. Contractor shall coordinate installation of equipment supplied by other approved equal manufacturers and shall make necessary field modifications to allow for installation of this equipment at no additional expense to the Owner.

D. Record Drawings: Refer to Division 1 requirements.

PART 2 - PRODUCTS

2.1 ELECTRICAL PROVISIONS OF HVAC WORK

- A. General: The electrical provisions of HVAC work, where indicated to be furnished integrally with HVAC equipment, can be summarized, but not by way of limitation, to include the following: 1) Motors, 2) Motor starters, 3) Control switch, pilot lights, interlocks, and similar devices, and 4) Drip pans to protect electrical work.
1. Temperature Control Sub-contractor (T.C.C.) shall furnish and install control wiring as part of the HVAC controls work.
 2. Power wiring, connections to equipment, motor control wiring and related work by Electrical Contractor.
 3. Motor starters, disconnects, relays, pushbuttons, pilot lights and related motor control items not furnished integrally with HVAC equipment shall be furnished by Electrical Contractor.
 4. Provide equipment list, locations and wiring diagrams to Electrical Contractor for all HVAC equipment requiring electrical connections.
- B. Motors:
1. Standards: Where not otherwise indicated, comply with applicable provisions of the NEC, NEMA Standards, and sections of Division 16 of specifications. All motors 1 HP and larger shall be NEMA Premium Efficiency motors meeting or exceeding values tested in accordance with IEEE Standard 112, Method B procedures as stated in NEMA MG 1-12.53a and shall be EPACT approved.
 2. Temperature Rating: Class B insulation for 70 degree C temperature rise, except where otherwise indicated or required for service.
 3. Phases and Current: 1/6 HP and smaller is Contractor's option; up to 1/2 HP, capacitor-start, 120 or 277 volt, 60 cycle single-phase; 1/2 HP and larger, squirrel-cage induction NEMA rated 208 or 477 volt, three-phase, 60 cycle.
 4. Service Factor: 1.15 for motors in drip-proof enclosures, all other enclosures to have minimum 1.0 service factor.
 5. Construction: Select motors for conditions in which they will be required to perform: i.e., general purposes, splash proof, explosion proof, standard duty, high torque or other special type as required by manufacturer's recommendations. Enclosures shall be of the type recommended by manufacturer for the specified application.
 6. Frames: NEMA Standard for horsepower specified.
 7. Bearings: Permanently lubricated and sealed ball bearings, 1/8 HP and less may be shaded pole type permanently oiled unit bearings.
 8. Overload Protection: Built-in thermal; with internal sensing device for stopping motor, and for signaling where required.
- C. Starters, Switches: All starters shall have thermal overload and low voltage protection, and shall comply with Electrical Division 16 sections of specifications.
- D. Wiring Connections:
1. Motors: Wired connections in flexible conduit, except where plug-in electrical cords are indicated and permitted by governing regulations.
 2. General Wiring: Comply with applicable provisions of Electrical Division 16 sections of specifications.
- E. Drip Pans: Furnish drain pans below piping which passes directly above electrical work. Locate pan immediately below piping and extend a minimum of 6 inches on each side of

pipng and lengthwise 18 inches beyond equipment. Fabricate of galvanized sheet metal or copper with 2 inch deep watertight pan, copper drain piping and drain valve

2.2 FLOOR, WALL, ROOF AND CEILING OPENINGS

- A. Provide sleeves for pipes and ducts passing through masonry, concrete or other similar construction. Openings for pipes shall be 1" larger in diameter than pipe passing through, including insulation, where indicated. Openings for ductwork shall be 1/2" larger on all sides than size of duct passing through, including duct insulation, where indicated. Coordinate additional space requirements for fire or smoke damper installation.
1. Pipe sleeves: Standard weight steel pipe.
 2. Duct sleeves: 24 gauge galvanized sheet metal, unless noted otherwise.
- B. Grout openings between sleeves and concrete or masonry walls and floors with sand-cement mortar consisting of one part portland cement and three parts sand, by volume. Add sufficient water to make a stiff placeable mortar.
- C. Close joints between sleeves and non-masonry walls and floors with suitable caulking applied over polyethylene foam backer, compatible with caulking used.
- D. Pack annular space between sleeves and insulation pipe or ducts with glass fiber blanket insulation and seal with Urethane caulking compound.
- E. Where penetrations occur through fire rated walls or floors, fill annular space with fire-resistive materials in compliance with a UL approved fire rated assembly. Seal annular space through fire rated walls or floors with a UL listed fire resistant sealant and materials in conjunction with the fire rated assembly.

2.3 CUTTING AND PATCHING

- A. General: Perform all cutting and patching required for complete installation of HVAC systems, unless specifically noted otherwise. Provide all materials required for patching unless otherwise noted. All cutting and patching necessary of structural members to install any HVAC work shall not be done without permission, and then only carefully done under the direction of the Architect.
- B. All new work cut or damaged shall be patched and restored to its original condition.

2.4 EQUIPMENT ACCESS

- A. General: All valves, volume dampers, equipment and accessories shall be installed to permit access to equipment for maintenance, servicing or repairs. Any relocation of piping ductwork, equipment or accessories required to provide maintenance access shall be accomplished by the HVAC Contractor at no additional cost to the Owner.
- B. Provide access doors where equipment is located in chases or generally inaccessible. Access doors used in fire-rated construction must have UL label. Minimum access panel size 12" x 12" or of sufficient size to allow total access for maintenance. Coordinate location with General Contractor.
- C. Access panels shall be furnished and installed by the HVAC Contractor in plaster walls, ceilings and related inaccessible surfaces.
- D. Access Doors: Milcor or approved equal, steel frames and door, prime coated, except stainless steel in areas subject to excessive moistures, such as toilet rooms.

2.5 EQUIPMENT SUPPORTS

- A. General: Provide all supporting steel and related materials not indicated on structural drawings as required for the installation of equipment and materials, including angles, channels, beams and hangers.

2.6 EQUIPMENT GUARDS

- A. General: Provide equipment guards over belt-driven assemblies, pump shafts, exposed fans and elsewhere, as indicated in this specification or required by code.

2.7 CONCRETE FOR HVAC WORK

- A. General: All concrete work necessary for HVAC equipment by the General Contractor.
- B. General Standards: Except as otherwise indicated, comply with applicable provisions of Division 3 for concrete work.
- C. Concrete Equipment Pads: For each piece of HVAC equipment as indicated on the drawings, arrange to install a 4" concrete housekeeping pad a minimum of 2 inches wider than full size of the respective equipment's base.

2.8 PAINTING HVAC WORK

- A. General: All painting of mechanical equipment will be done by the HVAC Contractor unless equipment is hereinafter specified to be furnished with factory applied finish coats. Coordinate the exterior finish painting and color of exterior HVAC equipment with the General Contractor.
1. Exposed ductwork in finished areas outside mechanical rooms shall be cleaned for accepting a paint finish or have factory-applied paint grip finish.
- B. Prime paint all field fabricated metal work under HVAC work, comply with applicable provisions of Division 9.
- C. All equipment shall be provided with factory applied prime finish, unless otherwise specified.
- D. Interior duct surfaces, dampers and other accessories visible through grilles, registers and diffusers shall be painted with flat black paint.
- E. If factory finish on any equipment is damaged in shipment or during construction of the building, the equipment shall be refinished by the Contractor to the satisfaction of the Architect.

2.9 HVAC SYSTEM IDENTIFICATION

- A. General: Provide adequate marking of HVAC system and control equipment to allow identification and coordination of maintenance activities and maintenance manuals. Tag and label HVAC equipment located in exposed or in accessible areas to conform to ANSI A13.1-1981. After painting and/or covering is complete, identify all equipment, piping and ductwork by its abbreviated generic name as shown/scheduled/specified.
- B. Equipment: Identify all major HVAC equipment with plastic-laminate signs or 2" minimum high painted stencils and contrasting background. Provide text of sufficient clarity and lettering to convey adequate information at each location and mount permanently. Identify control equipment by 1-1/2" x 4" plastic nameplates with 1/2" high lettering.

- C. Piping and Ductwork: Identify piping and ductwork once every 30 feet at each branch, at termination of lines, and near valve or equipment connections. Place flow directional arrows at each pipe or duct identification. Provide 2" minimum high letters on wrap-around siphonage, adhesive-backed or paint stenciled.
 - 1. Within boiler room provide piping identification every 10 feet and at each branch and termination.
- D. Valves: Identify all valves with 1-1/2" minimum polished brass stamp-engraved or plastic laminate tags. Prefix or color-code tags for each generic piping service. Prepare and submit valve tag schedule, listing location, service and tag description, incorporate in Instruction Manual. Mount valve tag schedule behind glass in mechanical room at location determined by Owner.
- E. Operational Tags: Where needed for proper or adequate information on operation and maintenance of HVAC systems, provide tags of plasticized or laminated card stock, typewritten to convey the message.

PART 3 - EXECUTION

3.1 HVAC WORK CLOSEOUT

- A. Lubrication: Upon completion of the work and before turning over to the Owner clean and lubricate all bearings except sealed and permanently lubricated bearings. Use only lubricant recommended by the manufacturer.
- B. Contractor is responsible for maintaining lubrication of all mechanical equipment under his contract until work is accepted by the Owner.
- C. Cleaning: After installation has been completed, Contractor shall clean all systems. All piping and ductwork shall be cleaned both internally and externally to remove all dirt, plaster dust or other foreign materials. All temporary throwaway or replaceable media air filters used during the construction period shall be replaced by new filters or new filter media after construction has been completed and before the building is turned over to the Owner. Check all strainers for clean screens.
- D. All dirt, plaster dust and other foreign matter shall be blown and/or vacuum cleaned from coils, terminal devices, diffusers, registers and grilles. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt and dust.
- E. Housecleaning and Cleanup: Periodically as work progresses and/or as directed by the Architect, the Contractor shall remove waste materials from the building and leave his area of work broom clean. Upon completion of work, remove all tools, scaffolding, broken and waste materials, etc., from the site.

3.2 INSTRUCTION AND MAINTENANCE MANUALS

- A. Instruction Manuals: Upon completion of work, but before final acceptance of the system, furnish to the Engineer for approval, three (3) instruction and maintenance manuals in loose leaf binders. One approved copy shall be returned for use during instructional period. Manual shall have an index of contents and tab for each piece of equipment or system, as well as the following:
 - 1. Manufacturer's O&M instructions, parts list and data sheets.

2. Copies of all shop drawings.
 3. Wiring diagrams.
 4. Start-up and shutdown procedures.
 5. Composite electrical diagrams, and flow diagrams.
 6. Test records.
- C. Equipment Parts Lists: Include a complete list of all equipment furnished for project, with a tabulation of descriptive data of all the equipment replacement parts proposed for each type of equipment or system. Properly identify each part of part number and manufacturer.
- D. Instruct Owner's maintenance personnel in the operation and maintenance of all equipment, including composite operating cycle of all equipment. Include not less than 8 hours of instruction, using the O&M manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment.
- E. Service Organizations: At time of substantial completion, Contractor shall provide Owner with listing of qualified service organizations, including addresses and telephone numbers for each piece of major equipment.

3.3 RECORD DRAWINGS

- A. Refer to Division 1 for further requirements.
- B. Maintain a record set of as-built drawings for all HVAC work performed. As-built drawings shall be continuously updated as the project progresses and be available for periodic inspection by the A/E.

3.4 GUARANTEE PERIOD

- A. Guarantee all equipment, materials, and workmanship to be free from defects for one year after acceptance by the Owner. Repair, replace or alter systems found defective at no extra cost to the Owner.
- B. At the time of substantial completion, turn over the prime responsibility for operation of HVAC equipment and systems to the Owner's operating personnel. During guarantee period, provide one operating engineer, familiar with the work, to consult with and continue training Owner's personnel on an as-need basis.

END OF SECTION

SECTION 23 05 90
TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. General Requirements: Contractor shall be responsible for providing complete test-adjust-balance (TAB) work of all hydronic and air systems including distribution systems and the equipment and apparatus connected.
- B. Work Included:
1. The extent of TAB work is indicated by the requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to, hydronic and air distribution systems, and associated equipment and apparatus of HVAC work.
 2. The work consists of setting speed and volume (flow) adjusting facilities provided for the systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the work as required by the Contract Documents.
 3. The component types of testing, adjusting and balancing specified in this section include but are not limited to the following HVAC equipment:
 - a. Air handling units and fan units.
 - b. Hydronic distribution.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
- | | | |
|----|----------|----------------------------------|
| 1. | 23 06 00 | Piping Specialties |
| 2. | 23 14 00 | Pumps |
| 3. | 23 74 00 | Terminal Air Distribution Units. |
| 4. | 23 74 20 | Gas-Fired Make-up Air Units. |
| 5. | 23 82 00 | Fans |
| 6. | 23 82 50 | Energy Recovery Units |
| 7. | 23 90 00 | Controls and Instrumentation |
| 8. | 23 96 00 | Starting of Mechanical Systems |

1.3 QUALITY ASSURANCE

- A. Tester: Performed by an Independent Trade who is specifically and actively engaged in the balancing business and regularly does such work. Certified by the NEBB (National Environmental Balancing Bureau), AABC (Associated Air Balance Council) or approved equal in those testing and balanced disciplines similar to those required for this project.
- B. Reference Standards: Comply with AABC's Pub. No. 12173, "National Standards for Field Measurements and Instrumentation, Total System Balance", as applicable to HVAC air and hydronic distribution system and associated equipment and apparatus.

- C. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.
- D. Submittals:
 - 1. Submit electronic PDF certified test reports and types of instruments used and their most recent calibration data with submission of final test report.
 - 2. Final test report shall bear the name of the person who recorded the data and the seal of the supervisor of the balancing trade.
- E. Guarantee: Guarantee that all TAB work be performed in accordance with NEBB or AABC standards and that all air systems operate within plus or minus 10 percent of the design flow rates as shown on the plans and/or as scheduled.

1.4 JOB CONDITIONS

- A. Do not proceed with testing, adjusting and balancing work until the work to be TAB'ed has been completed and is operable. Ensure that there is no latent residual work still to be completed.
 - 1. Do not proceed until the work scheduled for TAB'ing is clean and free from debris, dirt and discarded building materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Patching Materials:
 - 1. Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housing which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.
 - 2. At Tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housing.
- B. Test Instruments: Utilize test instruments and equipment for the TAB work required, of the type, precision and capacity as recommended for the following TAB standards: AABC's National Standards for Field Measurements and Instrumentation, Total Balance System.

PART 3 - EXECUTION

3.1 ADJUSTMENT AND TESTING

- A. Tester must examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work. Do not proceed with the TAB work until unsatisfactory conditions have been corrected in a manner acceptable to the Tester.

- B. Test, adjust and balance the environmental systems and components, as indicated, in accordance with the procedures outlined in the applicable standards.
- C. Prepare report of the test results including instrumentation calibration reports in format recommended by the applicable standards.
- D. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommended by the original Installer.
- E. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

3.2 AIR SYSTEMS

- A. Test, adjust and balance systems in accordance with the following procedure:
 - 1. Preliminary:
 - a. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals; check all system components for proper installation and operation.
 - b. Use manufacturer's ratings for all equipment to make required calculations except where field test shows ratings to be impractical.
 - c. Verify that all instruments are accurately calibrated and maintained.
 - d. Install clean filters furnished by the mechanical contractor in all equipment.
 - 2. Central System:
 - a. Test, adjust and record supply fan RPM design requirements within limits of mechanical equipment provided.
 - b. Test and record motor voltage and running amperes including motor nameplate data and starter heater ratings.
 - c. Make Pitot tube traverse of main supply, return and fresh air return ducts, determine and record CFM at fan and adjust fan to design CFM.
 - d. Test and record total system static pressure and suction and discharge static pressure across coils, filters and related air handling sections.
 - e. Test and adjust systems for design recirculated air; CFM.
 - f. Test and record cooling apparatus entering air temperatures; dry bulb and wet bulb.
 - g. Test and record heating apparatus entering and leaving air temperatures; dry bulb.
 - 3. Each Fan:
 - a. Each outlet and inlet average velocity, area, CFM.
 - b. Test and record total system static pressure at suction and discharge of fan coils.
 - c. Fan RPM motor RPM.
 - d. Motor name plate current testing.
 - e. Motor current draw.
 - 4. Distribution: Adjust zones or branch ducts to proper design CFM, supply; return and exhaust.
 - 5. Air Terminals:
 - a. Identify each air terminal from reports as to location and determine required flow reading.
 - b. Test, adjust and balance each air terminal to within 10% of design requirement. Record readings.

- c. Set minimum and maximum flow rates for VAV terminals at specified supply duct pressures and 90% system diversity (10% terminal units at minimum flow rate).
6. Verification:
- a. Prepare summation of reading of observed CFM for each system, compare with required CFM and verify that values are within 10% of specified quantities. Determine final coil and filter static pressure drops.
 - b. Verify design CFM at fans as described above.

3.3 HYDRONIC SYSTEMS

A. Test, adjust and balance system in accordance with following procedures:

- 1. Preliminary:
 - a. List all mechanical specifications of tested equipment verify against contract documents. Check all system components for proper installation and operations. Clean all screens.
 - b. Open all line valves to full open position. Close coil bypass stop valves, then set mixing control valve to full coil flow.
 - c. For each pump, verify rotation, test and record pump shut-off head and test and record pump wide-open head.
 - d. Verify proper water level in expansion tanks and in the system.
 - e. Verify that air vents in high points of water systems are installed and operating freely.
 - f. Verify that all instruments are accurately calibrated and maintained.
- 2. Central Equipment:
 - a. Set and record hot water pumps to proper flow quantity.
 - b. Adjust and record flow of hot and chilled water through boilers and chiller equipment to design quantities.
 - c. Observe and record leaving water temperature and return water temperatures at boiler, chiller equipment and zone water distribution loops. Reset to correct design temperatures.
 - d. Record pump operating suction and discharge pressures. Determine final dynamic head.
- 3. Distribution:
 - a. Balance and record flow to each hot and chilled water hydronic zone and terminal unit. For heating mode and cooling mode (chiller).
 - b. Adjust and record terminal unit flow rates and pressure drop.
 - c. Adjust and record coil flow rates and pressure drop. Verify entering and leaving water temperatures at coil terminals.

3.4 AUTOMATIC CONTROL SYSTEM

- A. Temperature control manufacturer's representative sets and adjusts automatically operated devices to achieve required sequence of operations.
- B. Testing organization verifies all controls for proper calibration and list those controls requiring adjustment by temperature control system installer.

END OF SECTION

**SECTION 23 06 00
PIPE AND PIPE FITTINGS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of pipe and pipe fitting work is indicated on drawings and by the requirements of this section.
- B. Types of pipe and pipe fittings required for this project include the following:
 - 1. Heating hot water.
 - 2. Refrigerant piping.
 - 3. Make-up water.
 - 4. Condensate and drainage.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 00 HVAC General Provisions
 - 2. 23 06 30 Piping Specialties
 - 3. 23 09 10 Supports and Anchors
 - 4. 23 10 00 Valves
 - 5. 23 63 00 Water Treatment

1.3 QUALITY ASSURANCE

- A. American National Standards Institute, ANSI:
 - 1. B31.1: Power Piping.
- B. Welder Qualifications:
 - 1. Prior to starting any metallic welding, Contractor shall submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.
- C. Employ piping materials meeting the latest revision of ASTM specifications as listed in this specification.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Where possible, store pipe and tube inside and protected from weather. When necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

- B. Prevent dirt and construction debris from accumulating inside the pipe and pipe fittings, cap open ends whenever possible. Store plastic pipe out of direct exposure to sunlight and support to prevent sagging and bending.

1.5 SUBMITTALS

- A. Submit schedule of pipe and pipe fittings showing manufacturer and catalog number.
- B. Submittal may be in the form of a typewritten list, with proper references, indicating service and pipe or pipe fitting specifications.

PART 2 - PRODUCTS

2.1 HOT WATER SYSTEM

- A. 2" and smaller:
 - 1. ASTM A-53 Type F, standard weight, schedule 40, black steel pipe with class 125, standard weight cast iron threaded fittings.
 - 2. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-joint fittings.
 - 3. Mechanical compression type fittings with integral o-ring seal, Viega ProPress or approved equal.
 - 4. Rated PEXa piping may provided from copper manifolds to terminal unit reheat coils.

2.2 REFRIGERATION PIPING

- A. ASTM B88 seamless, Type L, ACR hard temper copper tube with flare-type fittings or wrought copper ANSI/ASTM B32 grade 96TS silver-lead solder-joint fittings. Frost proof flare nuts on suction piping.
 - 1. Refrigerant grade tubing; cleaned, dehydrated and capped.

2.3 MAKE-UP WATER

- A. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-joint fittings.

2.4 CONDENSATE AND DRAINAGE

- A. 1" or less: Schedule 40 PVC piping; protect from foot traffic and physical damage. Solvent weld drainage pattern fittings.

2.5 DIELECTRIC UNIONS

- A. 1" and smaller: ASTM A197/ANSI B16.3 WOG malleable insulating unions with vulcanized fiber insulating sleeve and neoprene gasket, equal to Stockam Figure 693-1/2, or EPCO model FX or FB dielectric unions with Epconite No. 2 gasket, 250 PSIG at 210 degrees F.
- B. 1-1/2" and larger: EPCO model GX dielectric flange with Epconite No. 2 gasket, 175 PSIG at 210 degrees F.

- C. Clear flow dielectric fittings may be used in lieu of dielectric unions for pipe sizes 2" and smaller.

2.5 UNIONS AND FLANGES

- A. 2" and smaller:
 - 1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Copper unions with all copper piping. Stainless steel unions with all stainless-steel piping.
 - 2. Use unions of a pressure class equal to or higher than specified for the fittings of the respective piping service.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Set pipe on end and hammer sides to remove foreign materials before erection. Ream ends of all piping to remove burrs.

3.2 ERECTION

- A. Install all piping parallel to building walls and ceilings and at such heights not to obstruct any portion of window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings or other architectural details before installing piping.
- B. Provide anchors, expansion joints, swing joints and expansion loops so that piping may expand and contract without damage to itself, equipment or building.
- C. Mitered ells, notches tees and "orange peel" reducers are not acceptable. On threaded piping, bushings are not acceptable.
- D. "Weld-o-lets" and "Thread-o-lets" may be used for branch takeoff up to one half (1/2) the diameter of the main.
- E. Install drains throughout the systems to permit complete drainage of the entire system.
- F. Do not install piping through dedicated electrical rooms or spaces unless the piping is serving this room or space.
- G. Install 2" deep galvanized sheet metal drain pans below piping which passes over electrical switching apparatus. Pipe drain pans to an accessible location with a drain valve and hose bibb adapter such that the system may be drained without damage to other equipment, insulation or finished spaces.
- H. Install all valves, control valves and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.3 INSTALLATION OF PIPE

- A. Run pipe lines straight and true, parallel to building lines with minimum use of offsets and couplings.
- B. Provide only such offsets as may be required to provide necessary head room or clearance and to provide necessary flexibility in pipe lines.
- C. Changes:
 - 1. Changes in direction of pipe lines made only with fittings or pipe bends.
 - 2. Changes in size shall be made only with fittings.
 - 3. Do not use miter fittings, face of flush bushings or street elbows.
 - 4. All fittings of long radius type, unless otherwise indicated.
- D. Use full and double lengths wherever possible:
 - 1. Cut pipe to exact measurement and install without springing or forcing except in case of expansion loops where cold springing is indicated.
 - 2. Take particular care to avoid creating, even temporarily, undue loads, forces, or strains on valves, equipment or building elements either piping connections or piping supports.
- E. Install piping to allow for expansion and contraction without stressing pipe or equipment connected.
- F. Provide clearance for installation of insulation and for access to valves, air vents, drains, and unions.
- G. Sizing:
 - 1. Unless otherwise indicated, install all supply piping, including shut-off valves and strainers, to coils, pumps, and other equipment at line size with reduction in size being made only at inlet to control valve or pump.
 - 2. Install supply piping from outlet of control valve at full size connection in equipment served.
 - 3. Install outlet piping including dirt pockets or mud legs from equipment full size of connection in equipment served.
 - 4. Install piping, check valves, strainers, and shut-off valves in these equipment outlet or return lines beyond dirt pockets size of tapping in trap or if no trap, size of equipment connection.
- H. Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.
- I. Branch Take-Offs:
 - 1. Liquids: From top, bottom, or side of mains or headers at either 45 degrees or 90 degrees from horizontal plane.
 - 2. Use main sized saddle type branch connections or directly connecting branch lines to mains in steel piping if main is at least 1 pipe size larger than branch for up to 6 inch mains.

3. Do not project branch pipes inside main pipe.
4. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling.
5. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.

J. Pipe Drainage Provision:

1. Slope water piping 1 inch in 40 feet and arrange to drain at low points.
2. Closed Systems:
 - a. Equip low points with 3/4 inch valves and hose nipples.
 - b. At high points, provide collecting chambers and high capacity float-operated automatic air vents or manual air vents.

3.4 THREADED PIPE JOINTS

- A. Cut threads so that no more than three threads remain exposed after the joint is made. Ream all pipe ends after cutting and clean before erection. Use a thread lubricant when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.5 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the tube cut by reaming and filing both pipe surfaces. Clean fitting and tube with emery or sand cloth. Remove residue from the cleaning operation, apply flux and assemble joint. Use solder or brazing to secure joint as specified for the specific piping service.

3.6 WATER SYSTEMS

- A. Pitch horizontal mains up at 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.
- B. Main branches and runouts to terminal equipment may be made at the top, side or bottom of the main provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.
- C. Use top connection to main for upfeed risers and bottom connection to main for downfeed risers. Connections at a main may be made with a tee and a 45 degree elbow.
- D. Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for expansion and contraction of the piping system. Offset pipe connections at equipment to allow for service, such as removal of the terminal device.
- E. Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting. Concentric fittings may be used for changes in vertical pipe sizes.
- F. When other specification sections or piping details do not require a strainer upstream of each control valve, install bottom connections to a main with a capped dirt leg.

- G. Where copper piping is allowed for heating hot water or solar hot water systems, secure all joints and fittings with 95-5 tin-antimony solder or brazing alloys.
- H. Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. The collaring device shall be adjustable.
- I. Notch and dimple the branch tube. Braze the joint. Apply heat properly so that pipe and tee does not distort. Remove distorted connections.

3.7 REFRIGERATION PIPING

- A. After completion of refrigerant piping system and before charging, test piping with nitrogen at 350 PSIG for two hours without pressure loss. Isolate expansion and other accessories, which may be damaged by high pressure.
 - 1. Test joints for leaks with soap solution.
 - 2. After testing, introduce a mixture of refrigerant and dry carbon dioxide at 250 for two-hours without pressure loss.
 - 3. Test all joints including gauges, seals, expansion valves and devices.
 - 4. Rap joints with rubber mallet and check for leaks with electronic leak detector.
 - 5. Seal all leaks and retest.
- B. Evacuate and dehydrate piping system with vacuum pumps of proven micronic capacity. System temperature shall be above 60 degrees F during evacuation.
 - 1. Draw a vacuum of at least 2,500 microns on the system.
- C. Charge refrigerant into system to a pressure of zero (0) PSIG.
 - 1. Repeat evacuation to a vacuum of 2,500 microns and again charge with refrigerant to zero (0) PSIG, and repeat evacuation.
 - 2. Hold vacuum for 24 hours.
- D. Furnish first refrigerant and oil charge and make-up refrigerant required during guaranteed period.
- E. Do not insulate suction piping until piping has been successfully tested.

3.8 VENTS AND RELIEF VENTS

- A. Install vent line and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item.

3.9 COOLING COIL CONDENSATE

- A. Trap each cooling coil drain pan connection with a trap seal of sufficient depth to prevent conditioned air from moving through the piping. Extend drain piping to nearest code approved drain locations. Construct trap with plugged tees for cleanout purposes as detailed

3.10 DIELECTRIC UNIONS

- A. Install insulating or dielectric unions or flanges at each point where a copper to steel pipe connection is required in the following systems.
1. Cold water or non-potable make-up water lines.
 2. Hot water system.
 3. Dielectric unions shall not be used at terminal heating/cooling devices.

3.11 UNIONS AND FLANGES

- A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve.
1. Concealed unions or flanges are not acceptable.

3.12 PIPE SYSTEM LEAK TESTS

- A. Conduct pressure test with test medium of air or water unless specifically indicated. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- B. No systems to be insulated until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Minimum test time shall be as scheduled below plus such additional time as may be necessary to conduct the examination for leakage.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges. Measure and record test pressure at the high point in the system.
- D. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking.

E.

<u>System</u>	<u>Test Pressure</u>	<u>Medium</u>	<u>Duration</u>
Heat Water	100 PSIG	Water	8 hours
Refrigerant Piping	175 PSIG	Air/Nitrogen	8 hours

3.13 PIPE CLEANING

- A. Flush all water and condensate systems clear of all dirt and foreign matter with all pumps bypassed and all strainers removed from strainer bodies. Provide circulation by means of Trade Supplied portable pumping apparatus.
- B. After initial flushing of a system, use portable pumping apparatus for a continuous 24 hour circulation of a cold water detergent equal to Nalco 2567 cleaner. Flush detergent clear with

continuous draining and raw water fill for an additional 12 hours or until all cleaner is removed from the system. Replace strainers and reconnect permanent pumping apparatus.

3.14 INITIAL SYSTEM FILL AND VENT

- A. Fill and vent all systems with proper working fluids.
- B. Fluids to be chemically treated as specified in Water Treatment Section 15639B.

END OF SECTION

**SECTION 23 06 30
PIPING SPECIALTIES**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Thermometers, sockets and test wells.
- B. Pressure gauges.
- C. Pipeline strainers.
- D. Manual and automatic air vents.
- E. Flow sensors.
- F. Air Separators.
- G. Buffer Tanks.
- H. Refrigeration Specialties.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 06 00 Pipe and Pipe Fittings

1.3 QUALITY ASSURANCE

- A. Standards:
 - 1. American National Standards Institute, ANSI: B31.1: Power Piping.
 - 2. ANSI/ASHRAE 15, "Safety Code for Mechanical Refrigeration".

1.4 SUBMITTALS

- A. Submit shop drawings for all items including all data concerning dimensions, capacities, materials of construction, ratings, ranges, pressure drop and appropriate identification.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Construct devices for the highest pressures and temperatures existing in the respective systems in accordance with ANSI specifications.

2.2 THERMOMETERS

- A. Manufacturers: Marsh, Taylor, Trerice, U.S. Gauge, Weksler or Weiss.
- B. Pipeline mounted: Thermometers shall be mercury reading, 9" scale cast aluminum case industrial thermometers with clear acrylic plastic window front and adjustable angle stem to permit easy reading from the floor or operating platform. Furnish with extended necks suitable for insulated piping as required. Thermometers shall be compatible with sockets as specified herein.
- C. Panel or remote mounted: Thermometers shall be mercury vapor actuated dial type with remote bulb. Casing shall be 3-1/2" minimum diameter cast metal with double front. Sensing bulbs shall be of length to suit pipe diameter with extended necks as required for insulated piping, suitable for insertion in separable brass sockets as specified herein.
- D. The minimum range of thermometers shall be:

<u>Service</u>	<u>Scale Range</u>	<u>Increment</u>
Hot Water	30 deg. F to 240 deg. F	2 deg. F

- E. Thermometers by the temperature control manufacturer meeting the above specification will be acceptable.

2.3 THERMOMETER SOCKETS AND TEST WELLS

- A. Sockets and test wells shall be brass with threaded connections suitable for thermometer bulbs and control sensing devices. Socket and test wells length shall be suitable for pipe diameter with extended necks as required to suit pipe insulation.

2.4 PRESSURE GAUGES

- A. Manufacturers: Ashcroft, U.S. Gauge, Marsh, Taylor, Trerice, Weksler or Weiss.
- B. All gauges shall be suitable for the pressure service intended, with minimum 4-1/2" diameter dial cast aluminum case, double strength glass window, phosphor bronze bourdon tube with bronze bushed brass movement, and recalibration from the front of the gauge dial, 99% accuracy over the middle half of the scale.
- Gauges shall meet ANSI grade A specifications.
 - Gauges by the temperature control manufacturer meeting these specifications will be acceptable.
 - The minimum range of pressure gauges shall be:

	<u>Scale Range</u>	<u>Decrement</u>
Hot Water	0 PSIG to 100 PSIG	1 PSIG

- C. Pressure snubbers shall be 1/4" size and of all bronze construction, 300 PSIG working pressure. Coil siphons shall be 1/4" size and of bronze construction, 150 PSIG working pressure.
- D. Brass needle type gauge valves, Trerice model 735-2 or other approved product.

2.5 PIPELINE STRAINERS

- A. Manufacturers: Metraflex, Mueller Steam Specialty, Hoffman, Armstrong, Trane, Sarco, Keckley, Illinois.
- B. Strainers 2" and smaller: Full pipeline size, "Y" type, 250 psi W.P. steam, cast iron, with screwed ends. Furnish stainless steel strainer with a removable plug type screen retainer unless otherwise indicated on the drawings.
- C. Liquid service: Screens to be brass or stainless steel with 1/32" diameter perforation for sizes thru 2" and 1/16" diameter perforation for sizes over 2" for closed piping systems and 1/8" diameter perforation for open piping systems. Maximum pressure drop to be 4 feet W.G. in clean strainer.

2.6 AIR VENTS

- A. Manual air vents for components and pipe, Bell & Gossett Model 4V or other approved product, 125 PSIG at 210 deg. F. Use 1/2" gate valve for main pipes.
- B. Automatic air vents shall be pilot operated. Spirovent model spirotop, Thrush-Amtrol model 720, Watson McDaniel model 830, B&G model 107 or other approved product.
 - 1. Cast iron or bronze body with non-ferrous internal parts, designed to vent air automatically with float control.
- C. Vents shall be constructed of metal for maximum operating pressure of 150 psi and maximum operating temperature of 250 deg. F and all working parts shall be noncorrosive.
- D. Vents shall have minimum air elimination rate of 36 CFM at 80 PSIG and shall be fully open for the removal of air at all pressures in the operating range from 2 to 150 psi. It shall be tightly sealed against loss of system water and prevent entrance of air in negative pressure situations.

2.7 FLOW SENSORS

- A. Calibrated Balancing Valves:
 - 1. 2" and smaller: Construct valves of all bronze with threaded connections for sizes 2" and below and for 125 PSIG working pressure at a maximum temperature of 250 deg. F. Provide valve with quick disconnect taps with built-in check valve for pressure differential measurement and integral valve setting index.
 - 2. Select valves for size and pressure drop shown on the drawing and/or schedules. Tag valve plan mark number, flow and pressure drop as specified.
 - 3. Manufacturers: B&G CB plus calibrated balance valves or approved equal.

2.8 AIR SEPARATORS

- A. Approved Manufacturers: Spirovent.
 - 1. Micro bubble eliminator.
 - 2. Dirt separator.
- B. 1-1/2" and Smaller: Cast iron construction with steel diffuser tube, bottom and side threaded inlet connections, bottom and top threaded outlet connections, threaded top connection for air elimination, designed for a maximum working pressure of 125 PSIG.

- C. 2" and Larger: Cast iron or welded steel construction, flanged and/or threaded connections, perforated stainless steel air collector tube to direct air toward the air elimination connection at the top of the unit, tangential water inlet and outlet connections, bottom blow down connection, constructed in accordance with ASME boiler and pressure vessel code and stamped for 125 PSIG design pressure.
- D. Unless indicated otherwise, provide each unit with a removable galvanized steel system strainer with 3/16" diameter perforations and a free area not less than five times the cross sectional area of the connecting pipe.

2.9 BUFFER TANKS

- A. Tanks shall be constructed per ASTM A-569 steel certification of 12 or 14-gauge welded steel and factory insulated with foam insulation to meet R-14 value with an outer shell of high density polyethylene plastic. All tanks shall be factory tested for leaks at 1-1/2 times working pressure of 75 psig.
- B. Buffer tank shall include four (4) piping connections – two (2) high and two (2) low with a 1/2" brass automatic air vent at the top and 3/4" drain connection at the bottom. Provide threaded thermo well for installation of aquastat immersion sensor.
- C. Buffer tank shall be warranted for 3-years from manufacturing material defects and leaks.

2.10 REFRIGERATION SPECIALTIES

- A. Refrigerant Strainer: Brass shell and end connections, brazed joints, Monel screen, 100 mesh, UL listed, 350 psig working pressure.
- B. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL listed 299 degrees F temperature rating, 500 psig work pressure.
- C. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psig working pressure.
- D. Expansion Valves:
 - 1. Angle type or straight through design suitable for the 250 degree F temperature, 500 psig working pressure.
 - 2. Brass body, internal or external equalizer, and adjustable superheat setting, complete with capillary tube and remote sensing bulb.
 - 3. Size expansion valves to avoid of being undersized at full load and excessively oversized at partial load. Select valves for maximum load at design operating pressure and minimum 43 degrees F superheat.
 - 4. Provide electronic controlled expansion valves where scheduled and recommended by the equipment manufacturer for the application.

PART 3 - EXECUTION

3.1 PIPELINE STRAINERS

- A. Install strainers in steam and water systems on the entering side of all automatic valves and as shown on the drawings and details.
- B. Install strainers in water systems on the suction side of all pumps and elsewhere as indicated on the plans and/or as scheduled.
- C. Install drain valve with hose adapter in each blow off connection and extend drain piping to nearest floor drain.

3.2 THERMOMETERS

- A. Install thermometers in thermometer sockets in locations indicated on the drawings and details.
- B. Install sockets at each point where a temperature sensing device is required under Section 15900B - Controls and Instrumentation, and a thermometer location as shown on the piping drawings and details.

3.3 PRESSURE GAUGES

- A. Install pressure gauges where indicated on the drawings and details.
- B. Install gauges for water service with pressure snubbers and gauge valves.

3.4 PRESSURE GAUGE TAPPING

- A. Install tapplings at each point where sensing device is required under Section 15900B - Controls and Instrumentation and at gauge locations as shown on the drawings and details.
- B. Install tapplings for water service with pressure snubbers and gauge valves.

3.5 AIR VENTS

- A. Install manual air vents where indicated on the drawings, details and at all high points in water systems where air may collect.
- B. Install automatic air vent at the top of the air separator and where shown on drawings with a shut-off valve between air separator and air vent.

3.6 FLOW SENSORS

- A. Install flow sensors as indicated on the drawings and/or schedules and in accordance with the manufacturer's recommendations.

3.7 AIR SEPARATORS

- A. Install air separators in the locations as shown on the plans, details and/or schedules.
- B. Provide valved blow down connections and extend drain piping to nearest floor drain.

3.8 BUFFER TANKS

- A. Install buffer tanks in the locations as shown on the plans, details and/or schedules on concrete pad.
- B. Install thermostatic sensor in thermo well as scheduled.
- C. Provide valved blow down connections and extend drain piping to nearest floor drain.

3.9 REFRIGERATION SPECIALTIES

- A. Refrigerant Strainers: Install in refrigerant lines as indicated, and in accessible location for servicing.
- B. Moisture-Liquid Indicators: Install as indicated on refrigerant liquid lines, and in accessible locations.
- C. Refrigerant Filter-Dryers: Install in refrigerant lines as indicated, in accessible locations for service. Install with bypass assembly to permit isolation for servicing.
- D. Expansion Valves: Locate expansion valve sensing bulb immediately after evaporator outlet mounted on the suction line properly insulated.
- E. Install the expansion valve, indicator, solenoid valve and filter-drier as close to the evaporator as possible.

END OF SECTION

**SECTION 23 08 00
COMMISSIONING OF HVAC**

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PART 1 – GENERAL

1.1. SECTION INCLUDES

- A. Commissioning process requirements for HVAC&R systems, assemblies, and equipment.

1.2. RELATED SPECIFICATIONS

- A. Section 01 31 13 Project Management and Coordination
- B. Section 01 91 13 General Commissioning Requirements

1.3. DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxP: Commissioning Provider.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4. SUBMITTALS

- A. Certificates of readiness
- B. Certificates of completion, completed checklists, and test results for installation, prestart, and startup activities.

1.5. ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.6. CONTRACTOR’S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxP.
- B. Attend construction phase controls coordination meetings.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxP.
- E. Provide information requested by the CxP for final commissioning documentation.
- F. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- G. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- H. Provide building control system trend data as defined by the CxP in the MBCx Plan through the warranty period.
- I. Provide written notification to the CM/GC and CxP that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

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1.7 COMMISSIONING PROVIDER’S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual control systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct functional performance testing.
- C. Verify testing, adjusting, and balancing of works are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.8 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxP for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting and balancing report.

PART 2 – PRODUCTS [NOT USED]

PART 3 – EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxP.

3.2 TESTING AND BALANCE VERIFICATION

- A. Prior to performance of testing and balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxP.
- B. Notify the CxP at least 10 days in advance of testing and balancing work and provide access for the CxP to witness testing and balancing work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxP.
 - 9. The CxP will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 10. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 11. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

12. Remedy the deficiency and notify the CxP so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxP.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxP along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxP and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxP may direct that set points be altered when simulating conditions is not practical.
- H. The CxP may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxP with preparation of testing plans.
- B. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxP. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- C. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxP shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- D. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- E. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION

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**SECTION 23 09 10
SUPPORTS AND ANCHORS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Pipe hangers and supports for mechanical system piping.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 govern work under this section.
- B. Specified Elsewhere:
1. 23 06 30 Piping Specialties
 2. 23 20 00 Vibration Isolation
 3. 23 25 00 Mechanical Insulation

1.3 QUALITY ASSURANCE

- A. Standards:
1. ANSI B31.1: Power Piping
 2. MSS SP58 & SP69

1.4 SUBMITTALS

- A. Submit shop drawings for the following:
1. Schedule of all manufactured hanger and support devices, indicating type of device for each pipe size range and type of service, including shielding devices as specified.

1.5 MANUFACTURERS

- A. Grinnell, Fee and Mason, Michigan Hanger, B-Line or Elcen, or approved equal.
- B. Grinnell figures listed as reference only.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless otherwise specified.
- B. Design supports of strength and rigidity to suit loading, service, and in manner, which will not unduly stress the building construction. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Fasten supports and hangers to building steel framing whenever practical. Do not use perforated iron, chain or wire as hangers.

- C. Where piping can be conveniently grouped to allow the use of trapeze type supports, the supporting steel shall be by means of standard structural shapes or continuous insert channels. Where continuous insert channels are used, pipe-supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for approval.

2.2 EQUIPMENT SUPPORTS

- A. Provide all supporting steel, not indicated on the structural drawings, that is required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.
- B. Refer to HVAC Drawing details for further requirements.

2.3 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Grinnell, Fee and Mason, Michigan Hanger, B-Line or Elcen similar to the Grinnell figures listed.
- B. Pipe Hangers Application:
 - 1. 2" and smaller: Adjustable, swivel split ring type Grinnell Fig. 104 or lightweight, adjustable clevis type Grinnell Fig. 65.
 - 2. 2-1/2" and larger: Adjustable clevis type Grinnell Fig 260.
- C. Hangers for copper pipe without insulation shall be either copper plated or PVC coated.
- D. Hot piping 2" and smaller: Hanger may be secured directly to the pipe with insulation system around hanger.

2.4 INSULATION PROTECTION SHIELDS

- A. Application: Insulation protection shields are required on the following piping systems:
 - 1. Cold piping (under 60 deg. F): All sizes.
 - 2. Hot piping (over 120 deg. F): 2-1/2" and larger piping.
- B. Insulation Protection Shields: Grinnell Fig. 167, Fee & Mason or Elcen or other approved product, constructed of galvanized carbon steel. Select shield to accommodate outer diameter of insulation. Shield lengths and gauge shall be as follows:

<u>Pipe Size</u>	<u>Length</u>	<u>Gauge</u>
1/2" thru 2-1/2"	12"	18
3" thru 6"	18"	16
8" thru 12"	24"	14

2.5 HANGER SUPPORT INSULATION

- A. Application: Piping 2-1/2" diameter and larger in conjunction with insulation protection shields to resist compression of insulation system.

- B. Hanger insulation system shall cover bottom half of pipe at the same thickness as pipe insulation system.

2.6 PIPE HANGER RODS

- A. Support rods shall conform to the latest MSS standards except as modified herein.
- B. Size rods for individual hangers and trapeze support as indicated in the following schedule:

<u>Pipe size</u>	<u>Maximum Rod Diameter</u>	<u>Load (lbs.)</u>
Up to 2"	3/8"	610
2-1/2" and 3"	1/2"	1130
4" and 5"	5/8"	1810
6"	3/4"	2710
8" thru 12"	7/8"	3770

- C. Furnish rods complete with adjusting and lock nuts.
- D. In piping 4 inches and larger, each valve shall be supported.

2.7 HANGERS AND SUPPORT SPACING

- A. Space pipe hangers and supports in accordance with the following schedule, with exceptions as indicated herein:

<u>Pipe size</u>	<u>Steel</u>	<u>Copper</u>
Up thru 1-1/4"	8'-0"	6'-0"
1-1/2" and 2"	10'-0"	8'-0"
2-1/2" and 3"	12'-0"	10'-0"
4" and 5"	14'-0"	10'-0"
6" to 12"	14'-0"	10'-0"

- B. Place hangers to meet the requirements of the piping section of this specification, with regard to pitch for drainage and venting, and clearance between services.
- C. Place hangers within one foot of each elbow and at each valve and strainer for piping 4" and above.

2.8 BEAM CLAMPS

- A. Grinnell Fig. 87 Series beam clamps with retaining clip for hanger rods to 5/8". Maximum load 440 lbs.
- B. Grinnell Fig. 228 beam clamps with links for hanger rods 3/4" and above.

2.9 RISER CLAMPS

- A. Grinnell Fig. 261 for steel pipe, CT-121 for copper tubing.

2.10 CONCRETE INSERTS

- A. Grinnell Fig. 285, 281 or 282, poured concrete ceiling insert, suitable for rod diameter and weight supported.

- B. Inserts drilled and placed after concrete pour shall have steel shell with expander plug, not depending on soft lead for holding power.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install supports to provide for free expansion of the pipe. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Coordinate hanger and support installation to properly group piping of all trades.

3.2 INSULATION PROTECTION SHIELDS

- A. Install insulation protection shields at support points for insulated piping as scheduled herein.
- B. Spacing shall be 10'-0" maximum based on insulation with a compressive strength of 15 psi. For insulation with compressive strengths greater than 15 psi, span may be increased proportionally up to a maximum allowable as listed under hanger and support spacing in this section.

END OF SECTION

**SECTION 23 10 00
VALVES**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Valves for mechanical system piping.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 govern work under this section.

B. Specified Elsewhere:

- | | | |
|----|----------|----------------------------------|
| 1. | 23 05 90 | Testing, Adjusting and Balancing |
| 2. | 23 06 00 | Pipe and Pipe Fittings |
| 3. | 23 06 30 | Piping Specialties |

1.3 SUBMITTALS

A. Submit shop drawings for all valves including all data concerning dimensions, materials of construction and pressure/temperature ratings.

B. Mark shop drawings clearly for each system and note with the correct cross reference number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers: Powell, Crane, Nibco, Hammond, Stockham, Lunkenheimer, Milwaukee.

1. Valves shall be of same manufacturer, unless otherwise approved by A/E.

B. Acceptable manufacturer and Fig. No. are listed under each valve type as the standard for equal quality from approved manufacturers.

C. Manufacturer's name and pressure ratings clearly mounted on outside of valve body.

D. All valve packing to be non-asbestos and flexitallic type.

2.2 WATER SYSTEMS VALVES

A. Globe Valves:

1. Valves 2-1/2" and smaller: Bronze body, screwed pattern, renewable composition disc, union or screw-over bonnet, malleable iron hand wheel, 300 psi W.O.G., Mueller Fig. 203-AP or Metraflex No. 700.

B. Check Valves:

1. 2-1/2" and smaller: Bronze body, screwed, regrinding type, horizontal swing, renewable seat and disc, 150 SWP - 200 WOG rated. Nibco Fig. T-413-Y.

C. Spring Loaded Check Valves:

1. Valves 2-1/2" and smaller: Bronze or iron body, bronze trim, stainless steel spring, screwed, 250 psi WOG, Nibco Fig. T-480Y, Mueller Fig. 203-AP or Metraflex No. 700.

D. Balancing Valves(non-calibrated):

1. Valves 2-1/2" and smaller: Use eccentric plug valves or ball valves with memory stops.

E. Balancing Valves(calibrated):

1. Valves 2-1/2" and smaller: Refer to Section 23 06 30, Piping Specialties, under Flow Sensors and Meters.

F. Ball Valves:

1. Valves 2-1/2" and smaller: Bronze body, screwed, brass or stainless steel ball, full or conventional port, Teflon seat rings, blowout-proof stem, two-piece construction, 600 psi WOG, Apollo No. 70 Series, Milwaukee BA 100/150, Nibco T/S 585-70.
2. Provide valve neck extensions with sufficient length to allow for insulation where insulation is specified.

G. Drain Valves:

1. Bronze, screwed, Buna-N seat discs, hose thread adapter, 125 psi WOG, Nibco Fig 74, or ball valve as specified above with hose thread adaptor.
2. Minimum drain valve size - 3/4" except where strainer blowdown valves are indicated, drain valve same as blowdown connection size.

H. Combination Shut-off, Check and Balancing Valves:

1. 2" and smaller: Provide check valve and balance valve in series at pump discharge.
3. Design valves to permit repacking under full line pressure.

- I. Shut-off and Check Valves: Provide spring-loaded check valve and shut-off (ball or butterfly) valve in series at pump discharge.

2.3 WATER PRESSURE REDUCING VALVES

- A. Manufacturers: Thrush, Watts, Cash-Acme, Taco, or B&G valves.

- B. Valves shall be diaphragm operated and pressure adjustable with anti-siphon check valve and inlet strainer designed for a maximum working pressure of 125 PSIG at 240 deg F.

- C. Set the valves for pressures required, or as scheduled.

2.4 WATER RELIEF VALVES

- A. Manufacturers: Kunkle, Consolidated, Thrush, Watts, Cash-Acme, or B&G. Valves shall be iron or bronze body, diaphragm operated, with non-ferrous seat and designed for a maximum working pressure of 125 PSIG.
- B. Relief valves shall conform to State requirements and each valve shall have an ASME stamp.

2.5 GAUGE VALVES

- A. Trerice Fig. 735, 1/4" brass needle valve, threaded ends, 300 WOG rated.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install valves as shown on plans, details and according to the valve manufacturer's installation recommendations. Install valves with stems upright or horizontal.
- B. Install all temperature control valves furnished under Section 15900B - Controls and Instrumentation.

3.2 SHUT-OFF VALVES

- A. Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve for servicing.

3.3 THROTTLING VALVES

- A. Install globe or angle valves for throttling service and control device or PRV station bypass.
- B. Install gate valves for throttling in steam systems sizes 8 inches and larger.

3.4 BALL VALVES

- A. Ball valves shall be used for water system shut-off valves.

3.5 BALANCING VALVES

- A. Provide balancing valves for complete balancing of water systems. Furnish calibrated balance valves and flow meters as specified in Section 23 06 30, Piping Specialties, under Flow Meters.

3.6 DRAIN VALVES

- A. Provide drain valves where specified, detailed and at all low points of piping systems for complete drainage of the systems.

3.7 WATER RELIEF VALVES

- A. Install relief valves as shown on drawings.
- B. Unless otherwise indicated, provide one relief valve in each closed water system in the pump inlet piping.

3.8 SPRING LOADED CHECK VALVES

- A. Provide a spring loaded check valve in each pump discharge line.

3.9 COMBINATION SHUT-OFF, CHECK AND BALANCING VALVES

- A. Install combination or triple-duty (shut-off, check and balancing) valve in lieu of providing separate shut-off valve, check valve and balancing valve at water circulation pump discharge line.

3.10 WATER RELIEF VALVES

- A. Install water relief valves on closed system hydronic heating systems to relief rated system input capacity. Extend relief outlet to safe location near floor drain.

END OF SECTION

**SECTION 23 14 00
PUMPS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Types of pumps specified in this section include the following:

1. Inline Pumps

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 govern work under this section.

B. Specified Elsewhere:

1. 23 05 90 Testing, Adjusting and Balancing
2. 23 06 30 Piping Specialties
3. 23 10 00 Valves
4. 23 20 00 Vibration Isolation

1.3 QUALITY ASSURANCE

A. UL and NEMA Compliance: Provide electric motors and products which have been listed and labeled by Underwriters Laboratories and comply with NEMA Standards.

1.4 SUBMITTALS

A. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve, when applicable.

B. Submit all data concerning dimensions, materials of construction, ratings, and other relevant product data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide factory tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump are listed on pump schedule. Provide pumps of same type by same manufacturer.

B. Pump shall meet or exceed the operating efficiencies scheduled.

C. Select motor with sufficient horsepower rating for non-overloading operation over the entire pump curve.

D. All pumps shall operate without objectionable noise or vibration.

2.2 INLINE CENTRIFUGAL PUMPS

- A. General: Provide in-line pipe-mounted, single suction, centrifugal type pumps where indicated, and of capacities as scheduled.
- B. Acceptable Manufacturers:
 - 1. Bell and Gossett
 - 2. Grundfos
 - 3. Taco
- C. Casing: Cast iron bronze - fitted with a working pressure of 175 PSIG and operating temperature of 225 degrees F continuous, 250 degrees F intermittent. Provide tapped and plugged openings for vent, drain, suction and discharge gauge connections.
- D. Shaft: Alloy steel with integral thrust collar.
- E. Bearings: Oil lubricated bronze sleeve bearings or re-greasable ball bearings.
- F. Seal: Mechanical single unbalanced type with Buna-N/Carbon rotating element and ceramic, Ni-resist stationary seat or other approved product.
- G. Impeller: Single-suction enclosed type, hydraulically and dynamically balanced, and keyed to shaft. Bronze Construction.
- H. Motor: Non-overloading at any point on pump curve, open, drip-proof, oil-lubricated journal bearings, resilient mounted construction, built-in thermal overload protection on single phase motors.
 - 1. Motor shall be non-overloading over the entire pump curve.
 - 2. Premium efficiency motor per IEEE Standard 112, Method B and EPACT requirements.
- I. Nameplate: Each pump and motor shall be provided with a nameplate displaying the manufacturer's name, serial number of pump, capacity in GPM, and head in feet at design, horsepower, voltage, frequency, speed and full load current.
 - 1. Permanently identify exact impeller size of pump on nameplate.
- J. ECM Motor and Controller: Where scheduled, inline pump shall be equipped with an ECM motor with integral controller for constant pressure control of pump output as setup integrally on motor-mounted controller.

PART 3 - EXECUTION

3.1 INSTALLATION OF PUMPS

- A. Install pumps where indicated, in accordance with manufacturer's published installation instructions, with recommended clearance provided for service and maintenance.

- B. Install in-line pumps supported from piping system, located for access to oil cups, service and maintenance. Pipe to be free of all movement.
- C. Provide piping, accessories, hangers, supports, and anchors, valves, meters and gauges, vibration isolation, and equipment supports, as indicated for completion installation. All valves and piping specialties are to be full line sizes as indicated on drawings.
 - 1. Install a full line size silent spring loaded check valve and balancing valve in the pump discharge piping.
 - 2. Provide line size ball or butterfly valve and strainer on suction piping.
 - 3. Provide supports under elbows on pump suction sizes 4 inches and over.
- D. Lubricate pump before start-up. Start-up in accordance with manufacturer's instructions.
- E. Ensure that pump units are wired properly, with rotation in correct direction, and that pump and motor grounding have been provided.
- F. Start-Up Services and Inspection Report: Manufacturer's representative shall inspect pump installation and start-up pump to verify proper installation, pump shaft alignment and operation, and submit report to Engineer.

END OF SECTION

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**SECTION 23 20 00
VIBRATION ISOLATION**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of vibration isolation work required by this section is indicated on drawings and schedules, and/or specified in other Division 15 sections.
- B. Types of vibration isolation products specified in this section include the following:
 - 1. Vibration Isolation Springs.
 - 2. Flexible Duct Connectors.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 86 00 Ductwork Accessories

1.3 DESIGN CRITERIA

- A. Isolate all motor driven mechanical, unless otherwise noted, from the building structure, and from the systems which they serve, to prevent equipment vibrations from being transmitted to the structure.
- B. Consider equipment weight distribution to provide uniform deflections.
- C. For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.

1.4 SUBMITTALS

- A. Submit shop drawings of isolation devices indicating isolation materials, isolator heights both free & operating, isolator dimensions, deflections, and isolation efficiency based on lowest operating speed.

1.5 SUPERVISION AND INSPECTION

- A. Vibration isolation manufacturer or his qualified representative to provide supervision to assure correct installation and adjustment of the isolators.
 - 1. Upon completion of the installation and after the system is put into operation, the manufacturer, or his representative, shall make a final inspection and submit his report to the A/E in writing, certifying the correctness of installation and compliance with the specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All isolation devices shall be designed for the equipment with which they will be used. Materials used shall retain their isolation characteristics for the life of the equipment served. All elastomeric materials shall be industrial grade neoprene.
- B. Isolation devices subject to weather shall have hot-dipped galvanized finish and be furnished with limit stops to resist wind.
- C. Coordinate the selection of devices with the isolator and equipment manufacturer.

2.2 MANUFACTURERS

- A. Products and methods of fabrication shall be as manufactured by Mason Industries, Korfund Co., Amber/Booth Co., Vibration Mounting & Controls, or Kinetics, similar to the manufacturers model listed.

2.3 TYPE FD FLEXIBLE DUCT CONNECTORS

- A. Laminated flexible sheet of cotton duct and sheet elastomer (butyl, neoprene or vinyl), reinforced with steel wire mesh where required for strength to withstand duct pressure indicated. Form connectors with full-faced flanges and accordion bellows to perform as flexible isolation units. Equip each unit with galvanized steel retaining rings for airtight connection with ductwork.

2.4 TYPE D HANGERS

- A. Mason type 30N, vibration hangers with steel spring and 0.3" deflection neoprene element in series. Neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box shall permit hanger rod to swing 30 deg. arc before contacting the hole and short circuiting the spring.
- B. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

2.5 PERFORMANCE

- A. Select all vibration isolation devices to provide minimum 95% isolation efficiency or based on the minimum static deflection and mounting criteria listed below, whichever greater.

	Floor Span					
	<u>On Grade</u>		<u>20 feet</u>		<u>30 feet</u>	
	Min.	Static	Min.	Static	Min.	Static
	<u>Type</u>	<u>Defl.</u>	<u>Type</u>	<u>Defl.</u>	<u>Type</u>	<u>Defl.</u>
B. 1. <u>Suspended Fans:</u>	--	--	FD-D	1.5"	FD-D	1.5"

Note: Air Handling Units are internally isolated and do not require external vibration isolation.

PART 3 - EXECUTION

3.1 GENERAL

A. Except as otherwise indicated, apply the following types of vibration isolators at indicated locations or for the following indicated items of equipment. Selection is Installer's option where more than one type is indicated.

B. Spring Isolators:

1. Suspended Fans

C. Flexible Duct Connectors:

1. Duct connections with air handling equipment mounted on vibration isolators.

3.2 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contact or bearing points.

B. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

C. Install vibration isolation devices as specified, as shown on the drawings and according to the manufacturer's installation instructions.

D. In no case shall the installation short circuit the isolation device. Flexible piping connections are to be installed on the equipment side of shut-off valves.

END OF SECTION

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**SECTION 23 25 00
MECHANICAL INSULATION**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of mechanical insulation required by this section is indicated on drawings, and by requirements of this section.
- B. Work shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for piping, ducts and related mechanical equipment in the Heating, Ventilating and Air Conditioning Systems.
- C. The following types of insulation are specified in this section:
 - 1. Pipe insulation.
 - 2. Duct insulation.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 09 10 Support and Anchors
 - 2. 23 84 00 Ductwork

1.3 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Owens-Corning
 - 2. Schuller
 - 3. Certainteed
- B. All insulating products delivered to the construction site shall be labeled with the manufacturer's name and description of materials.
- C. All insulation installation methods shall be performed in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions, except as modified in this section of specifications.

1.4 DEFINITIONS

- A. Concealed Ductwork: Concealed areas, where indicated in this section, shall apply to shafts, furred spaces, space above finished ceilings, low tunnels and crawl spaces.
- B. Exposed Ductwork: Exposed ductwork, include mechanical rooms, walk-through tunnels, and similar installations subjecting ductwork insulation to physical damage and tearing.

1.5 SUBMITTALS

- A. Submit shop drawings for insulation systems, including a schedule for all insulating materials, including adhesives, fastening methods, fitting materials, installed thickness and intended use of each material.
- B. Submittal shall include catalog sheets indicating density, thermal characteristics, jacket, and installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All products including vapor barriers and adhesives shall conform to NFPA Section 90A. All products except pipe insulation shall possess a flame spread rating of not over 25, without evidence of continued progressive combustion, and a smoke developed rating no higher than 50.

2.2 PIPING INSULATION SCHEDULE

- A. Insulation Thickness Pipe Size Schedule:

Type of System	Fluid Temp. Range Deg F	*Run-outs Up to 2"	1" and Less	1-1/4" -2"	2-1/2" -4"	5&6 inch	8"& Up
<u>Hot Water:</u>							
Low Temp.	141-200	0.5	1.0	1.0	1.5	1.5	1.5
<u>Cooling Systems:</u>							
Refrigerant Suction	40-55	0.5	0.5	0.75	1.0	1.0	1.0
Cond. Drains	40-55	0.375	0.375	0.5	0.5	0.5	0.5

*Runouts are extensions to individual terminal units not exceeding 12 ft. in length.

- B. Insulation thickness shown in schedule are based on products having a maximum "k" factor of 0.26 at a mean temperature of 75 degrees F. These thicknesses can be reduced for products having significantly lower "k" values and shall be increased for products having higher "k" values in order to produce equivalent or greater thermal resistance. ("R" value of products equals the thickness of the insulation divided by the "k" factor.)

- C. Insulation Application Schedule:

Type of System	Fluid Temp. Range (deg. F)	Type of Insulation
<u>Hot Water:</u>		
Low Temp/HWS&R	141-200	Glass Fiber
<u>Cooling Systems:</u>		
Refrigerant Suction	40-55	Elastomeric
Cond. Drains	40-55	Elastomeric

2.3 PIPE INSULATION

- A. Rigid molded glass fiber pipe insulation with ASJ type factory applied jacketing with a density of 3-4 lbs./cubic feet and a "k" factor of 0.25 @ 75 degrees F. mean. (Flame Spread 25, smoke development 50 per ASTM E 84-75, -20 degrees to 500 degrees F. usage.)
1. Jacket shall be glass fiber reinforced foil kraft laminate, factory applied, with white finish. Permeance shall not exceed 0.02 perms. Beach puncture resistance shall be 50 units minimum.
 2. Provide Aluminum or UV-resistant PVC jacket for all exposed exterior piping insulation.
- B. Flexible elastomeric thermal insulation with a "k" factor of 0.26 at 75 degrees F mean density of 5.0 lbs./cu. ft. and a maximum water vapor transmission of 0.17 per inch. Seal joints with manufacturers standard sealant. (Armaflex AP-Flame Spread 25, smoke development 50 per ASTM E 84-75, -40 degrees to 220 degrees F usage.)

2.4 DUCTWORK INSULATION

- A. Material: Flexible Glass Fiber Wrap: Flexible glass fiber insulation shall have a minimum density of 0.75 PCF with thermal conductivity of not more than 0.31 at 75 degrees F mean temperature and suitable for 240 degrees F with FSK aluminum foil reinforced vapor barrier jacket. Material shall meet NFPA 90A and 90B.
1. Jacket shall be glass fiber reinforced foil kraft laminate factory applied with paintable white finish. Permeance shall not exceed 0.04 perms. Beach puncture resistance shall be 15 units minimum.

2.5 DUCTWORK INSULATION SCHEDULE

- A. Supply Air Ducts - Concealed:
1. Type Insulation: 1-1/2" Flexible Wrap (R5 min).
- B. Supply Air Ducts - Exposed:
1. Type Insulation: 1" Rigid Board (Unconditioned spaces - Mech. Rms.).
Note: Insulation not required if supply duct is lined. Refer to Section 15840B.
 2. Exposed ducts in conditioned spaces do not require external insulation.
- C. Exhaust and Tempered Exhaust Air Ducts - General Exhaust:
1. Automatic Control Damper (ACD) to Ambient Outlet (Louver):
1-1/2" Flexible Wrap (Concealed).
 2. Exhaust Registers to Fan Inlet: None.
- D. Fresh and Tempered Fresh Air Ducts:
1. Fresh Air: 1" Rigid Board (exposed) or 1-1/2" Flexible Wrap (concealed).
- E. Transfer Air Ducts:
1. Type Insulation: 1" Acoustic Duct Liner. Refer to Section 15840B.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Application of insulation materials to piping, equipment, tanks and ductwork shall be done in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer and required by applicable codes.
- B. All insulation shall be continuous through wall and ceiling openings and sleeves. All covered pipe and ductwork is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. (If necessary, extra fittings and pipe are to be used.).

3.2 PIPING INSTALLATION

- A. All pipe installation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to the adjoining insulation by one of the following methods:
 - 1. Premolded PVC fittings installed in accordance with the manufacturer's instructions.
 - 2. Jackets on pipe insulation laps are to be vapor sealed using self-sealing lap, lap-seal tape gun or adhesive such as Armstrong 520. All insulation ends are to be tapered and sealed regardless of service.
- B. Provide removable insulation sections to permit easy access where inspection, service and/or repairs are required.
 - 1. Insulation for valves, unions (cold only), strainers, flexible connections and expansion joints shall be removable for inspection and repair.
- C. On all cold piping insulated with vapor barrier covering, use protection shield to over bottom one-half of insulated pipe. Provide half-round, 12" long, hanger block at the bottom half of the pipe in place of the fiberglass pipe insulation. The hanger blocks shall be molded cork or calcium silicate pipe insulation of the same thickness as the adjoining fiberglass pipe insulation. The vapor barrier jacket shall be continuous through the hanger location.
 - 1. Provide removable elastomeric insulation wraps over cold piping unions.
- D. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers on cold lines (dual temperature piping) are to be sized large enough to be installed over the outer surface of the insulation.
- E. On hot piping 2" and smaller, the hanger shall be secured directly to the pipe and the pipe insulation shall surround the hanger. Provide pipe covering protection saddles and hanger blocks at hanger locations on hot piping 4" and larger.
- F. Insulation shall preferably be applied while surfaces are hot. Chilled water lines shall be at room temperatures when insulation is applied.
- G. Omit insulation for the following:

1. Discharges piping from safety and relief valves to outlets.
 2. Piping unions on hot only (HWS&R) systems.
 3. Provide removable insulation jackets over unions and valves for hot/chilled water systems.
 4. Hot water piping inside convector, wall fin radiation and cabinet heater enclosures.
- H. Seal all exposed end sections of pipe covering with a coat of vapor barrier mastic. Childers CP-30 or equal.
- I. No covering shall be applied until after piping is cleaned and tested, inspected and approved.

3.3 DUCTWORK INSULATION INSTALLATION

- A. Insulation shall be installed per manufacturer recommendations with mechanical fasteners. Seal all joints and fasteners with UL labeled vapor proof tape.
- B. Provide finished edges at all access doors and ends.

3.4 INSTALLATION OF EQUIPMENT INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork surfaces prior to insulating, Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these locations.
- E. Do not insulate factory insulated equipment.

3.5 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction; period, to avoid damage and deterioration.

END OF SECTION

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**SECTION 23 62 00
HEATING HOT WATER BOILERS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of heating hot water boiler work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of heating hot water boiler specified in this section include the following:
 - 1. Modular hot water condensing boilers.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.

1.3 QUALITY ASSURANCE

- A. Installers: Contractors certified Contractors for installation of boilers, of types and capacities required, with similar installations in satisfactory use in similar service for not less than 3 years.
- B. Regulatory Requirements:
 - 1. AGA Compliance: Provide heating hot water boilers that have been tested and rated in accordance with American Gas Association.
 - 2. NFPA Compliance: Install gas-fired hot water boilers in accordance with National Fire Protection Association (NFPA) Code 54 "National Fuel Gas Code".
 - 3. ASME Compliance: Construct hot water boilers in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section IV.
 - 4. UL Labels: Provide heating hot water boiler ancillary electrical components which have been listed and labeled by Underwriters Laboratories (UL).
- D. Warranty:
 - 1. Sealed combustion boiler, condensing, hi-efficiency, (modular,) helical heat exchanger/combustion chamber design that will be self-supporting, and warranted for a period of 10 years to withstand thermal shock. Heat exchanger shall be warranted against leakage for a period of 10 years.
 - 2. Heat exchanger/combustion chamber assembly: 3 years.
- E. Start-Up Services: Contractor shall provide factory authorized supervision of all phases of equipment start-up.
 - 1. Manufacturer-approved start-up technician shall commission startup of boilers and boiler plant controller.
 - 2. Startup Technician shall document operational parameters and submit report itemizing measured parameters and approving the boiler installation.

3. Provide a startup report and Manufacturer's letter of compliance with all factory recommendations and installation instructions.

1.4 SUBMITTALS

- A. Shop drawings of product data and manufacturer's installation and maintenance manual.

PART 2 - PRODUCTS

2.1 HOT WATER BOILERS

- A. General: Provide as indicated, modular units of capacity as scheduled. Provide net ratings approved by AGA, and construct in accordance with requirements of ASME Boiler and Pressure Vessel Code. Boilers shall be gas-fired sealed combustion complete with all accessories.
 1. Provide units with capacity and operating characteristics indicated on schedules.
 2. AGA Design certified input = 19.9-199,000 BTU/HR.
 3. Heating capacity = 18.8-188,000 BTU/HR.
 4. Conversion efficiency AFUE = 95%.
 5. 10:1 turn down.
- B. Approved Manufactures: Lochinvar, IBC and Laars.
- C. Boiler ASME stamped for 160 psig and designed per ASME section IV. Furnish a relief valve in compliance with ASME section IV, and set at 30 psig. All internal combustion chamber, and internal burner components, shall be manufactured with materials suitable to withstand constant operation under condensing conditions. Combustion chamber shall have a condensate drain to discharge any condensate buildup.
- D. Boiler efficiency 95%+ per ANSI Z21.13a, and operation in the condensing mode with inlet temperatures as low as 90 F.
- E. Combustion air intake capable of accepting either free mechanical room air, or direct outside air through a sealed intake pipe of the length and diameter shown on drawings. Provide inlet/outlet combustion vent temperature fittings with direct outside air application.
- F. Category IV flue vent connection, condensing positive pressure, for both roof and sidewall venting. The vent outlet shall be compatible with PVC/CPVC plastic vent material.
- G. Baked enamel finish boiler sheet metal jacket with removal panels for maintenance access.
- H. Inlet and outlet temperature gauge to monitor inlet and outlet water temperatures.
- I. Provide a water temperature controller with integral outdoor reset with customizable reset curves, outdoor air sensor and hot water supply header sensor. Controller shall employ electronic PID modulating control to maintain setpoint hot water header

temperature. Provide auxiliary contacts for external 4-20ma or 0-10VDC BAS signal to reset of hot water supply, if selected. BACnet protocol controller with network link.

- J. Provide each boiler shall be provided with a hydronic flow switch to prevent operation without proper flow.
- K. Provide each boiler with dual over temperature protection, including manual reset, in accordance with ASME Section IV and CSD-1.
- L. Boiler control panel shall be equipped with an LCD display and keypad to setup control parameter and provide diagnostic interface with operator.
- M. Provide remote fault alarm contact for flame sensor and high temperature limit failure.
- N. Provide integral primary boiler pump compatible with required boiler flow requirements and powered from boiler relay contacts. The primary pump shall be capable of serving the boiler's heat exchanger flow requirements with 10 feet equivalent external piping losses.
- O. Provide single point 115 volt 1-phase wiring for controls and combustion fan.
- P. Natural gas-fired burners, forced draft power type with a positive pressure at the boiler discharge. Stainless steel burner mixer. Maximum Nox emissions under 20 PPM.
 - 1. Gas burner shall modulate down to 10% capacity (10:1 turndown).
- Q. Furnish units with fuel trains and operating controls conforming to the latest UL or equivalent agency approval, and shall be factory assembled, wired, mounted, and factory fire tested.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which boilers are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BOILERS

- A. General: Comply with boiler manufacturer's instructions for installation, except as otherwise indicated.
- B. Comply with installation requirements of local and state boiler codes, and applicable provisions of NFPA and ASME boiler code standards.
- C. Install boilers on 4" high concrete pad where indicated, maintain manufacturer's recommended clearances around and over top of boilers.
- D. Install boiler trim not installed at factory.
- E. Connect water, fuel, piping, and venting as indicated.

- F. Furnish to Electrical installer, manufacturer's wiring diagram and electrical requirements for installation of field-wiring required for heating hot water boilers, not work of this section.
- G. Flush and clean heating hot water boiler upon completion of installation, in accordance with manufacturer's start-up instructions.
- H. Start-up heating hot water boilers, in accordance with manufacturer's start-up instructions, and in presence of boiler manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning control and equipment.
- I. Hydrostatically test assembled boiler and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.
- J. Arrange with National Board of Boiler and Pressure Vessel Inspectors of inspection of boiler piping, observation of hydrostatic testing, and for certification for completed boiler unit.
- K. Install a drain valve at low point to boiler assembly.
- L. Each boiler is to have a butterfly valve for isolation and maintenance, along with a calibrated balance valve for flow balancing between boilers.

3.3 TRAINING OF OWNER'S PERSONNEL

- A. Certified Installation: The HVAC Contractor shall be a certified to install and start-up boilers per approved manufacturer's prior training.
- B. Start-Up Services: Contractor shall provide factory-certified supervision of all phases of boiler installation and start-up services.
 - 1. Furnish factory-certified installation compliance and start-up report at completion of project.
 - 2. Provide factory training for Owner's maintenance personnel on the operation and maintenance of the boiler system.
- C. Schedule training with Owner, provide at least 7-day notice of Owner and Engineer of training date.

END OF SECTION

**SECTION 23 63 00
WATER TREATMENT**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section includes requirements for water treatment related to the following:
 - 1. Closed Loop Treatment System
 - 2. Pipe Cleaning and Inhibiting Treatment
- B. Specification of an item in this section shall not relieve the HVAC Contractor from providing all items, materials, operations, methods, labor, equipment and incidentals necessary for a complete and functional system.
- C. All services will be performed by a qualified, full-time representative of the water treatment company.
 - 1. Coordinate water treatment with Owner's current water treatment program for compatible chemicals and treatment methods.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 06 00 Pipe and Pipe Fittings

1.3 SUBMITTALS

- A. Submit product data, installation and operating instructions.

1.4 SUPERVISION AND INSPECTION

- A. Water treatment manufacturer or his qualified representative to provide supervision and final inspection upon completion of installation and adjustment, shall submit report in writing, certifying the correctness of the installation in compliance with the specifications and proper operation.

PART 2 - PRODUCTS

2.1 CLOSED LOOP TREATMENT SYSTEM

- A. Water treatment consists of initial chemical type treatment to clean piping and prevent rust and scale in final fill treated water.
 - 1. Sequestering agent to reduce deposits and adjust pH.
 - 2. Corrosion inhibitors.
 - 3. Conductivity enhancers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Heating Contractor will provide initial fill treatment to each closed-loop system. After this initial treatment, the Owner shall be responsible for all future service requirements.
- B. Furnish start-up chemical treatment chemicals, procedures and certification after installation is complete.
- C. After start-up treatment, the treatment company shall be responsible for all water treatment service requirements for one year, to include the following treatment services performed by qualified, full-time representatives of the treatment company.
 - 1. Initial water analysis and recommendations.
 - 2. Initial equipment clean-up chemicals, procedures and certification after clean-up is complete.
 - 3. Assistance during start-up of the treatment program.
 - 4. Instructions of operating personnel on proper feeding and control techniques.
 - 5. Periodic service and consultation meetings.
 - 6. Any necessary record forms and log sheets.
 - 7. Any required laboratory and technical assistance.

3.2 PIPE CLEANING AND INHIBITING GUIDELINES

- A. Cleaning: Hydronic water piping system shall be cleaned by using a solution consisting of a blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors and containing propylene glycol, methyl ether, phosphonates, sodium-meta-silicate-hydrate and sodium hydroxide.
 - 1. The material shall not contain tri-sodium phosphate.
 - 2. The piping system shall be filled, vented and circulated employing the chemical cleaner solution for a period of at least 24 hours or more in accordance with the manufacturer's recommendations and job site chemical tests. Water filters shall be removed from the system for this cleaning. The concentration shall be brought to a level which raises the M Alkalinity to a value of 250 above that for the existing water used for the fill.
 - 3. Chemical tests shall be made to verify these levels and submitted to the A/E. The system should be circulated, drained and flushed to achieve the original M Alkalinity level.
- B. Inhibitor:
 - 1. The inhibitor shall be added to the system after it is acceptably cleaned and flushed and refilled. The inhibitor shall consist of a boron nitrite, benzol thiazol, benzotriazole, mercapto-benzo-thiazole, tolyltriazole silicates and color trace all producing a scale and corrosion inhibitor system. The inhibitor shall be chemically installed to a concentration of 700 to 1000 parts per million and the solution shall be tested to indicate that it falls within this range.
 - 2. Test results shall be submitted to the A/E.
 - 3. The strainer baskets may be remounted before the system is inhibited.

C. Supervision:

1. The chemical supplier shall supervise the addition, the testing of the flushing and draining of all chemical scale and inhibitor solutions for all systems. Three copies of the chemical water status shall be submitted to the A/E for final approval.
2. Cleaning, inhibiting and testing of the piping systems shall be carried out in the presence of the owner's representative.

END OF SECTION

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SECTION 23 66 00
AIR-COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Pad and rail mounted condensing units.
- B. Refrigerant piping and controls.
- C. Refrigerant charge.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 00 HVAC General Provisions
 - 2. 23 06 00 Pipe and Pipe Fittings
 - 3. 23 06 30 Piping Specialties
 - 4. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Air Conditioning and Refrigeration Institute, ARI:
 - a. ARI 210: Unitary Air Conditioning Equipment.
 - b. ARI 270: Sound Rating.
 - 2. Underwriter's Laboratories, UL: Conform to requirements of UL.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit with shop drawings, schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
 - 2. Submit complete pipe sizing data and piping schematic for refrigerant piping with valves and refrigerant specialties indicated.
 - 3. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Air Cooled Condensing Units:
 - 1. AAON
 - 2. Carrier

3. Trane

2.2 TYPE AND PERFORMANCE

- A. Self-contained, packaged, factory-assembled and prewired units suitable for outdoor use consisting of cabinet, compressors, condensing coils and fans, integral sub-cooling coil, controls, liquid receiver, wind deflector, and screens.
 1. Refrigerants: R-410A as scheduled.
 2. Two circuits, where scheduled.
- B. Minimum Operating Condition EER: 12.0.
- C. Electrical Service: 460 volt, 3-phase, 60 Hertz.

2.3 MATERIALS

- A. Use corrosion-resistant materials for parts in contact with refrigerant.
- B. Timer circuits to prevent rapid loading and unloading of compressor.

2.4 CABINET

- A. Galvanized steel (14 gauge) with anti-corrosion, baked enamel finish, and removable access doors or panels with quick fasteners.
 1. 2500 hrs salt spray tested exterior paint finish.
- B. PVC coated steel wire condenser coil guard.

2.5 COMPRESSORS

- A. Hermetically sealed, 1750 or 3500 RPM, resiliently mounted compressor with positive lubrication, crankcase heater, motor overload protection, service valves, and filter-drier.
 1. Modular scroll compressors.
 2. Digital modulating capacity scroll compressors, where scheduled as lead compressor.
- B. Extended compressor warranty: 5 years.

2.6 CONDENSER

- A. Coil: Seamless copper tubing with aluminum fins.
- B. Fans: Vertical discharge, direct-drive axial fans, resiliently mounted with guard and motor.
- C. Motors: Permanently lubricated ball bearing motors with built-in current and overload protection.

2.8 CONTROLS

- A. High and low pressure cut-outs for compressor, oil pressure control, anti-cycle timer 5 min. (adj.) and reset relay.
- B. Accessory Controls: As scheduled on Drawings.
 - 1. Digital scroll compressor with modulating capacity (0-5 VDC control signal).
 - 2. Low-ambient (35 deg F) modulating condenser fan speed (ECM motor) controlled by refrigerant condensing pressure.
 - 3. Anti-corrosion paint finish.
- C. Unit Controls:
 - 1. 115 volt 1-phase fusing and control power transformer.
 - 2. Magnetic contactors for compressor and condenser.
 - 3. High/low pressure cutouts.
 - 4. Reset relay.
 - 5. Anti-recycle compressor timer.
 - 6. Terminal strip for Temperature Control Contractor interface and control of cooling enable/disable and steps or modulation.
 - 7. Unit disconnect circuit breaker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.
- B. Furnish charge of refrigerant and oil.

3.2 FIELD QUALITY CONTROL

- A. Start-up: Supply initial charge of refrigerant and oil for each refrigeration system.
- B. Testing:
 - 1. Charge system with refrigerant and test entire system for leaks after completion of installation.
 - 2. Repair leaks, put system into operation, and test equipment performance.
 - 3. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative.
 - 4. Repeat start-up and testing operation at beginning of first cooling season.
- C. Manufacturer's Start-up Test Report and Acceptance:
 - 1. Submit start-up test report and acceptance letter from Manufacturer's representative indicating the air-cooled condensers are properly installed and piped for refrigerant flow.
 - 2. Test report shall indicate operating pressures and temperatures for the suction and liquid lines under normal cooling operation.

END OF SECTION

SECTION 23 74 00
TERMINAL AIR DISTRIBUTION UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of terminal air distribution unit equipment work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of terminal air distribution unit equipment required for project include the following:
 - 1. VAV Boxes with reheat (hot water).
- C. Refer to other Division 23 temperature control system sections for control work required in conjunction with air distribution equipment.

1.2 RELATED DOCUMENTS

- A. Applicable provision of Division 1 governs work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 06 30 Piping Specialties
 - 3. 23 25 00 Mechanical Insulation
 - 4. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. IBR Compliance: Provide terminal heating units bearing the IBR Hydronics Institute Certified Rating Seal.
- B. AMCA Compliance: Provide air distribution equipment bearing the Air Movement and Control Association, Inc. (AMCA) Certified Rating Seal.
- C. UL Compliance: Provide air distribution equipment electrical components which have been listed and labeled by Underwriter Laboratories (UL).

1.4 SUBMITTALS

- A. Submit shop drawings for all equipment including all data concerning dimensions, air flow capacities, sound ratings, unit pressure drop, finish and appropriate identification.
- B. Submit certified sound data for both casing discharge and radiated sound levels from 125 thru 8000 Hz as tested in accordance with Air Diffusion Council (ADC) Test Standard 1062R4.

PART 2 - PRODUCTS

2.1 VARIABLE AIR VOLUME BOXES

- A. General: Provide single-duct VAV boxes of size and arrangement as indicated on Drawings, and of capacities and having accessories as scheduled.
- B. Housing: Factory assembled unit with welded 26-gauge galvanized steel casing, acoustically and thermally lined with 1" thick 3 PSF fiberglass with high-density facing. Leakage rate 2% maximum at 0.5 inch W.G. Insulation to be UL listed and meet NFPA 90A requirements.
 - 1. Provide bottom or side access panel for air valve.
 - 2. Provide bottom or side access panel upstream and downstream of reheat coil. Access panel shall be large enough to allow proper cleaning of reheat coil without dismantling ductwork.
- C. Air Valves: Air flow control device with integral actuator. Electronic volume regulator supplied by Temperature Control Contractor, factory or field installed. Integral flow ring sensor with taps and calibration chart to measure air flow with 10% regardless of inlet connections.
- D. V.A.V. Box Control: DDC/Electronic actuators, sensor wiring and application-specific controller supplied by Temperature Control Contractor, field-installed.
- F. Hot Water Coil: Performance and rated capacities as indicated on schedules on Drawings.
 - 1. Hot water coil with aluminum fins mechanically bonded to 5/8" OD seamless copper tube. Same end connections.
 - 2. Coil leak tested at 300 PSIG air pressure, under water.
 - 3. Provide duct extensions for access panel installation upstream of reheat coil to clean coil surface.
- G. Acceptable Manufacturers:
 - 1. Enviro-Tec
 - 2. Carnes
 - 3. Titus

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which terminal air distribution units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TERMINAL AIR DISTRIBUTION EQUIPMENT

- A. Install terminal air distribution equipment where indicated, in accordance with equipment manufacturers installation instructions, and with recognized industry practices to ensure that equipment complies with requirements and serves intended purposes.
 - 1. Provided proper service clearance space for controls and damper actuators.
 - 2. Provide duct access panels upstream and downstream of reheat coils.

- B. Coordinate with other work, including ductwork, piping and control work as necessary to interface installation of terminal air distribution equipment with other work.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of terminal unit equipment, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, and then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

END OF SECTION

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**SECTION 23 74 10
GAS-FIRED HEATING UNITS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of gas-fired heating unit equipment work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of gas-fired heating unit equipment required for project include the following:
 - 1. Gas-fired Radiant Heating Units.
 - 2. Gas-fired Unit Heaters.
- C. Refer to other Division 23 temperature control system sections for control work required in conjunction with gas-fired heating equipment.

1.2 RELATED DOCUMENTS

- A. Applicable provision of Division 1 governs work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. AGA American Gas Association
- B. ANSI Z83.4 Direct Gas Fired Makeup Air Heaters
- C. GAMA Gas Appliance Manufacturers Association
- D. NEC National Electrical Code
- E. UL Compliance: Provide air distribution equipment electrical components, which have been listed and labeled by Underwriter Laboratories (UL).

1.4 WARRENTY

- A. Radiant heat tubes warranted against internal corrosion for 10 years. Remainder of infrared radiant heater components warranted for 1 year from date of startup.

1.5 SUBMITTALS

- A. Submit shop drawings for all equipment including all data concerning dimensions, air flow and heating capacities, sound ratings, unit pressure drop, cabinet construction, finish and appropriate identification.

PART 2 - PRODUCTS

2.1 GAS-FIRED RADIANT HEATING UNITS

- A. The entire system shall be AGA certified "Gas Infrared Heaters" conforming to ANSI standard Z83.6. All wiring shall comply with the National Electrical Code.
1. System configuration and performance as indicated on the drawings and/or equipment schedules.
- B. Overall system and sub-systems certified for use with [natural][propane] gas, as indicated on the drawings. Each comprised of burner unit, outside air inlet, combustion pipe, radiant pipe, reflectors, support brackets, vacuum fan(s) (separate from burner unit), exhaust pipe, thermostats and safety controls.
1. Provide gas regulator, automatic gas valves and safety interlocks on gas train.
 2. Unit is to be non-condensing type.
- C. Burner and associated controls shall include, direct spark ignition, electronic flame monitoring, "power on" and "burner on" indicator lights, 100% gas safety shutoff in case of ignition failure, pre-purge and post purge of system and air flow switch to prove combustion air flow prior to firing burner.
- D. The combustion pipe shall be constructed of 16 gauge aluminized steel for a minimum of 10'. The radiant pipe shall be constructed of spiral wound 22 gauge aluminized steel. Construct flexible connector between vacuum fan and pipe of stainless steel.
- E. Direct drive 115 volt combustion fan to exhaust all combustion gases to the outdoors.
- F. Provide polished aluminum or polished stainless steel reflectors over all heat exchanger piping including elbows, u-bends and fittings.
- G. Provide single point 115v power connection at burner unit. Vacuum fan power to be field wired to burner. (Power wiring by Division 26 00 00 - Electrical contractor. Thermostat and control wiring by this contractor)
- H. Furnish a low voltage or 115 volt wall mounted thermostat. If low voltage is used then provide factory installed control transformer.
- I. Approved Manufacturers:
1. Detroit Radiant Products Co. (Re-Verber-Ray).
 2. Roberts-Gordon (Co-Ray-Vac).
 3. Combustion Research Corp (Reflect-O-Ray).
 4. Ambi-Rad.

2.2 GAS-FIRED UNIT HEATERS

- A. General: Furnish power-draft, gas-fired unit heaters as indicated on Drawings and Equipment Schedules.

- B. Unit heater shall be rated for output at minimum 83% conversion efficiency. Provide factory assembled furnace AGA certified with induced-draft combustion air fan, separated combustion system, direct-drive fan and propeller mounted on vibration isolators, electronic intermittent ignition system and 20 year warranty heat exchanger.
 - 1. Reznor UDX series or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which gas-fired heating units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF GAS-FIRED HEATING UNITS

- A. Install gas-fired heating units where indicated, in accordance with equipment manufacturers installation instructions, and with recognized industry practices to ensure that equipment complies with requirements and serves intended purposes.
- B. Coordinate with other work, including recessed wall installations, floor-mounted construction, and control work as necessary to interface installation of gas-fired heating units with work of other Trades.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of gas-fired heating unit equipment, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment, which cannot be satisfactorily corrected.

END OF SECTION

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SECTION 23 74 20 GAS-FIRED MAKEUP AIR UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Direct-fired, Make-up Air Units.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified elsewhere:
- | | | |
|----|----------|----------------------------------|
| 1. | 23 05 90 | Testing, Adjusting and Balancing |
| 2. | 23 90 00 | Controls and Instrumentation |
| 3. | 23 96 00 | Starting of Mechanical Systems |

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
- | | |
|----|--|
| 1. | Reference Standards: |
| | AGA American Gas Association |
| | ANSI Z83.4 Direct Gas Fired Makeup Air Heaters |
| | ANSI Z83.6 Gas Fired Infrared Heaters |
| | ANSI Z21.64 Direct Vent Central Furnaces |
| | GAMA Gas Appliance Manufacturers Association |
| | NEC National Electrical Code |
- B. WARRANTY:
1. Gas-fired primary and secondary heat exchangers warranted for 20 years under normal use and maintenance. Remainder of heating components warranted for 1 year from date of startup

1.5 SUBMITTALS

- A. Refer to division 1, General Conditions, Submittals.
- B. Submit complete product data, manufacturer's installation instructions and accessories required for complete system.

PART 2 - PRODUCTS

2.1 DIRECT-FIRED MAKE-UP AIR UNITS

- A. Furnish fully assembled and wired gas-fired direct-fired make-up air units in the size and capacity as shown on the Drawings.

- B. Furnish fully assembled and wired direct-fired make-up unit with blower/filter section, and duct furnace section in the size and capacity as shown on the Drawings and specified herein. Designed for 100% make-up air applications with ETL certified compliance with ANSI Standard Z83.18 and Z83.4.
- C. Casing: Shall be complete with insulated double-wall, galvanized steel construction in weatherized cabinet, hinged side panels, filters (2" 30% - MERV 8) and filter rack. Unit shall be configured for downward discharge as specified with curb mounting. Access panels shall employ locking cams with tool-less door access handles to access equipment.
- D. Bonnet Section: AGA certified and constructed of AGA defined corrosion resistant material with a built-in draft diverter. Burners shall be cast iron construction with stainless steel mixing plates.
Burner shall employ an electronic modulating gas design for minimum 25:1 turndown ratio.
- E. Blower Section: Shall be factory installed with NEMA standard motor, IEC contactor or starter, dynamically-balanced class I or II centrifugal blower fan.
- F. Gas Train:
1. Units shall be provided with gas valves suitable for Class 2, maximum inlet pressure of 0.5 psi (14 inch W.C.) on natural gas.
 2. The 24-volt combination automatic gas valves must include a main operating valve, pilot safety shutoff, pressure regulator, manual main and pilot shutoff valve, and adjustable pilot valve.
 3. Gas valves shall be electronic modulating gas valve. Ignition shall be at full fire (100% input) and modulate the gas input from 100 to 4% rated input. Gas valve shall be energized through duct thermostat control with reset from the space selector thermostat. Maxitrol Series 14 amplifier or approved equal.
- G. Controls:
1. A factory installed control box or junction box shall be provided for all power connections. A 24-volt control transformer, high limit, and fan time delay relay must be provided. Fan time delay relay will delay the fan start until the heat exchanger reaches a predetermined temperature and allow the fan to operate after burner shutdown to remove residual heat from the heat exchanger.
 2. A solid-state ignition control system shall ignite the pilot by spark during each cycle of operation. When pilot flame is proven, main burner valve shall be open to allow gas flow to burner. Pilot and burners must be extinguished during the off cycle.
- H. Accessories: (Refer to Schedules for further requirements)
1. Low voltage duct thermostat, modulating control and remote-control station as scheduled for discharge air temperature control.
 2. 120 volt/1-phase electric service with control transformers.
 3. Filter section with locking access door.
 4. Double-wall construction.
 5. Painted enamel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with all applicable codes, standards and local utility requirements. Install units per manufacturer's instructions.
- B. Connect natural gas line to gas-fired equipment and adjust pilot flame, gas input and pressure per manufacturer's recommendations.
- C. Install and adjust integral and remote temperature controls for proper operation.

END OF SECTION

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SECTION 23 76 30 AIR HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section includes material specifications and installation requirements for air handling units, coils mounted in the units and other accessories normally furnished by the equipment supplier.
- B. Types of air handling units with coils specified in this Section.
 - 1. Horizontal Draw-Thru Units.
 - 2. Horizontal Inline Relief Fan.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 89 50 Variable Frequency Drives
 - 3. 23 90 00 Controls and Instrumentation
 - 4. 23 96 00 Starting of Mechanical Systems

1.3 SUBMITTALS

- A. Submittals are required for all material in this section.
- B. Submittals shall include all data concerning dimensions, capacities, materials of construction, weights, appropriate identification and fan curves.
 - 1. Fan curves shall include a series of curves indicating the relationship of CFM and static pressure for various RPM, brake horsepower curves, and selection range (surge curves, maximum RPM, etc.).
 - 2. Indicate operating point on the fan curves at design air quantity and at 110 percent of design air quantity.
 - 3. For variable air volume application, indicate all operation points on the fan curves.

1.4 MANUFACTURERS

- A. Daikin
- B. Trane
- C. Carrier
- D. Johnson Controls

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- A. Furnish units complete with fans, motors, coils, drain pans, filter sections, face and bypass, air blending and mixing sections as shown on the plans and/or as scheduled. All materials shall meet requirements of NFPA 90A.
- B. Units shall have the configuration as indicated on the plans and/or as scheduled.
- C. Each fan and motor combination shall be capable of delivering plus 10% of the air quantity scheduled at the scheduled static pressure.
- D. Air handling unit static pressure shall take into consideration the actual static pressure loss of the components furnished within the unit.
- E. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, submit a scaled layout of the change and system effect factor calculations, indicating increased static pressure requirement as described in AMCA Publication 201. This Trade shall be responsible for any motor, drive and/or wiring changes required as a result of duct configuration changes at the fan.

2.2 CASING

- A. Unit casing shall be constructed of factory-painted finish 18-gauge G90 galvanized steel throughout, with steel framework. Casings shall be furnished with removable panels to provide access to all internal parts. Units shall be constructed air tight and water tight, shall be rust inhibited and furnished prime coated or galvanized. Closed cell foam gasketing shall be employed where modules are joined.
- B. Unit casings shall be double-wall solid-liner construction of 2-inch thermally broken double-wall construction with injected foam insulation for an R-value of not less than R-13. All connecting channels shall be insulated to prevent sweating.
- C. Drain pan to be insulated, double-wall stainless steel construction under cooling coil sections. Provide drain connection on both sides.
- D. Air handling unit and accessories shall be furnished with a nameplate which includes model number, serial number and unit tag number.
- E. Casing sections with internal fan and motor isolation packages do not require piping vibration isolators, piping flexible connectors or external vibration isolation.

2.3 FANS

- A. Fans shall be double width, double inlet centrifugal or single width single-inlet air foil plenum fan type, statically and dynamically balanced in unit fan section. Fans shall be securely fastened to solid or hollow steel shafts and shall be designed for continuous operation at the maximum rate static pressure.
 - 1. Housed fan performance shall be certified as complying with ARI standard 430-89.
 - 2. Centrifugal fans shall be dynamically balanced at factory as a complete fan assembly.
 - 3. Fan shafts shall not exceed 75% of their first critical speed at any cataloged RPM.

- B. Bearings shall be internally mounted and provided with an extended grease line and fitting to allow servicing without entering or dismantling of the unit. Bearings shall be self aligning, anti-friction pillow block bearings with a minimum life of L-50 200,000 hours.
- C. Fans shall be provided with a belt guard to insure that no rotating parts are exposed. Provision shall be made so that a tachometer may be used to verify fan speed without removing the belt guard assembly.
- D. Provide variable pitch V-belt drives for purposes of system balancing within 5% of specified RPM.
- E. Fan and motor assembly shall be internally isolated from unit casing with spring isolators furnished and installed by unit manufacturer. Fan scroll shall be attached to the unit casing by a flexible canvas duct.

2.4 MOTORS

- A. Motors shall have characteristics consistent with the torque and speed of the fans being driven. All motors shall be NEMA frames and be rated in accordance with NEMA performance standards for continuous full load performance at 40 degrees C temperature rise above ambient, with a 1.15 service factor. Motor horsepower and voltage shall be as scheduled.
- B. The motor furnished with the fan shall not operate into the motor service factor. Drive efficiency shall be considered in motor selection according to manufacturers published recommendations, or according to AMCA publication 203.
- C. Furnish premium-efficiency motors per Section 23 05 00. Provide VFD compatible motors where fans are controlled by VFD drives.
 - 1. Provide unit-mounted VFD drives with disconnects, where scheduled.

2.5 WATER COILS

- A. Construct coils of 1/2" or 5/8" O.D. min. copper tubes with aluminum fins suitable for working pressures to 200 PSIG.
- B. Coil fins shall be the continuous or plate fin type. Maximum fin spacing 10 fins per inch.
- C. Construct coil headers of cast iron with tubes expanded into the headers, steel pipe with brazed tube connections, or of heavy seamless copper with all tubes brazed to the header.
- D. Casing shall have galvanized steel end supports and top and bottom channels of rigid construction with allowance for expansion and contraction of the finned tube section.

2.6 REFRIGERANT COILS

- A. Construct coils of 1/2" or 5/8" O.D. min. copper tubes with aluminum fins suitable for working pressures to 200 PSIG.
 - 1. Provide distributor quantities as scheduled for multiple DX stages.
- B. Coil fins shall be the continuous or plate fin type. Maximum fin spacing 12 fins per inch.

- C. Construct coil headers of cast iron with tubes expanded into the headers, steel pipe with brazed tube connections, or of heavy seamless copper with all tubes brazed to the header.
- D. Casing shall have galvanized steel end supports and top and bottom channels of rigid construction with allowance for expansion and contraction of the finned tube section.

2.7 FILTERS

- A. MERV 13 Filter Media: Air filters shall consist of disposable 4" thick, pleated, lofted, non-woven, cotton and synthetic media, reinforced fabric, supported and bonded to a welded wire grid, and enclosed in cardboard frame. UL Class 2.
 - 1. Media nominal rating shall be 500 FPM face velocity, 0.30 inch W.G. initial resistance.
 - 2. Filter shall provide a minimum of 4.6 S.F. of media per square foot of filter face area and shall contain not less than 15 pleats per linear foot.
- B. Provide extra set of prefilter media to be used during the construction period.

2.8 MIXING BOX SECTION

- A. Furnish mixing box sections where indicated on Drawings. Dampers shall be low-leakage type with fully gasketed continuous vinyl seals and stainless steel jamb seals rated at less than 0.2% leakage at 2" pressure differential per AMCA Standard 500.
- B. Casing shall be insulated equal to air handler with access door in section.
 - 1. Provide access door at mixing box section for mounting actuators.

2.9 BI-POLAR IONIZATION

- A. Furnish bi-polar ionization air treatment where indicated on Drawings. The air purification system(s) shall be of the size, type, arrangement and capacity indicate and required by the unit furnished and shall be of the manufacturer specified.
 - 1. Basis of Design: Global Plasma Solutions GSP-iMOD.
 - 2. Ionization bars shall be mounted downstream of the cooling coil. Quantity and length shall be determined by manufacturer for proper air treatment efficiency.
 - 3. Control unit shall be mounted either internal or external to air handling unit housing.
- B. EQUIPMENT REQUIREMENTS: Electrode Specifications (Bi-polar Ionization):
 - 1. Each alternating current (AC) Ionization Bar with Bi-polar Ionization output shall Include a minimum of eighteen carbon fiber cluster ion needles per foot of coil face width shall be provided.
 - 2. The entire cooling coil width shall have equal distribution of ionization across the face.
 - 3. Systems without ion needles at least 0.50" (12.5mm) apart shall not be acceptable.
 - 4. The plasma electrode shall require no more than 1.0" (25mm) in the direction of airflow for mounting.
 - 5. All hardware required for mounting shall be provided by the air purification manufacturer except self-tapping screws for the power supply.

6. Electrodes shall be provided in 6.0" (150mm) increments, epoxy filled for an IP55 rating and utilizing brass connection hardware that is recessed into the connection joint once fully engaged and assembled.
7. Electrodes shall be energized when the main unit disconnect is turned on.
8. The ionization output shall be a minimum of 60 million ions/cc per inch of cooling coil width as measured 1 inch from the cold plasma needles.
9. Ionization bars shall be provided with magnet mounting kits to prevent penetration into cooling coils.
10. Ionization bars shall be constructed of UL 94VO and UL746C composite material.

2.10 VIBRATION ISOLATION

- A. All units shall be provided with internal, factory-installed internal vibration isolation for the fan section.

2.11 ACCESSORIES

- A. Provide factory installed filter section air pressure drop magnahelic gauge (0-1.00 W.G.) at each filter section.

PART 3 - EXECUTION

3.1 AIR HANDLING UNIT INSTALLATION

- A. Install units according to manufacturer's instructions in locations as indicated on the drawings and as detailed.
- B. All units shall be installed on concrete pad, factory-mounted rail or welded steel stand, as indicated or specified.
- C. Sufficient room shall be allowed for maintenance of the equipment and for removal of coils and the fan shafts.
- D. Install all belts, sheaves and motors to form a complete drive package for each fan according to the manufacturer's recommendations.
- E. Belt tension and alignment shall be inspected and corrected, if necessary, every week after start-up until corrections are no longer necessary.
- F. Install belt gauge so that belts are completely enclosed. Provisions shall be made for measuring fan speed with a tachometer without removing entire guard.
- G. Provide drains connections from coils with shutoff valve. Trap height 1/2" and total static pressure. Mount units at proper height above floor so that proper trap depth is provided.

3.2 COILS IN GENERAL

- A. Install coils in factory packaged air handling units or on a structural steel frame for field erected air handling units as indicated on the drawings and/or as detailed. Pitch coils for proper drainage according to the manufacturer's installation.

- B. Comb out fins when bent or crushed before enclosing coils in housing. Clean dust and debris from each coil to ensure its cleanliness.
- C. Provide offsets in piping to facilitate coil removal. Unless otherwise specified, pipe coils for counterflow arrangement.
- D. Provide air vent and drain valve at each coil.

3.3 ASSEMBLY & ERECTION: PLASMA GENERATOR

- A. All equipment shall be assembled and installed in a workman like manner to the satisfaction of the owner, architect, and engineer. Coordinate electrical requirements with electrical trade.
- B. Any material damaged by handling, water or moisture shall be replaced, by the mechanical contractor, at no cost to the owner.
- C. All equipment shall be protected from dust and damage on a daily basis throughout construction.
- D. Provide the manufacturers recommended electrical tests.

END OF SECTION

SECTION 23 82 00 FANS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of fan work is shown on drawings and schedules, and by requirements of this section.
- B. Types of fans required for project include the following:
 - 1. Propellor Wall Fans.
 - 2. Centrifugal Inline Fans.
 - 3. Ceiling Mounted Fans.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 20 00 Vibration Isolation
 - 3. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. Manufacturers:
 - 1. Greenheck
 - 2. Carnes
 - 3. Cook
- B. AMCA Compliance: Provide fans bearing the Air Movement and Control Association, Inc. (AMCA) Certified Rating Seal.
- C. UL Compliance: Provide power roof ventilator electrical components which have been listed and labeled by Underwriters Laboratories (UL).

1.4 SUBMITTALS

- A. Submittals shall include all product data, performance, materials of construction, and installation instructions.

PART 2 - PRODUCTS

2.1 PROPELLOR WALL FANS

- A. Propellor Wall-Mtd Exhaust Fans: Provide direct-drive propeller type wall mount exhaust fans as scheduled on drawings. Accessories (as indicated on plans and schedules).

1. Fans shall be complete with wall sleeve, fan guard and motorized or gravity backdraft damper.
 2. The fan shall be quiet operating and vibration free. Fan performance shall be certified by AMCA ratings seal. The fan shaft shall be mounted in permanently lubricated ball bearing pillow blocks.
 3. The fan motor shall be a NEMA approved, ball bearing with type with thermal overloads.
- B. Accessories: As specified herein and indicated on drawings schedules:
1. ECM motor with remote 0-10VDC input control.

2.2 CENTRIFUGAL INLINE FANS

- A. Centrifugal inline fans shall be direct-driven, centrifugal type, as scheduled on drawings.
- B. The fan wheel shall be centrifugal with backward inclined, airfoil, or forward curved blades, as scheduled. The fan wheel shall be statistically and dynamically balanced. The fan shall be quiet operating and vibration free. Fan performance shall be certified by an AMCA ratings seal.
- C. The fan shaft shall be mounted in lubricated ball bearing pillow blocks. Bearings shall be provided with grease fittings and caps. Bearings shall be rated for 200,000 hours.
- D. The fan housing shall be steel construction. Belt drives shall have a sliding or pivoting motor plate for belt tensioning, and the belt shall be totally enclosed by a belt guard with tachometer holes. The fan motor shall be a NEMA approved, ball bearing type. Provide casing access for checking fan speeds. Provide variable-speed control switch when scheduled.
- E. Accessories: As specified herein and indicated on drawings schedules:
2. Spring vibration isolation supports.
 3. ECM motor with remote 0-10VDC input control.
 4. Flexible duct connections.

2.3 CEILING MOUNTED FANS

- A. Ceiling Mounted: Furnish ceiling-mounted exhaust fans complete with centrifugal blower, inlet grille, gravity back-draft damper, and discharge duct connection as shown on the drawings. Fan shall be AMCA certified with a sound rating of less than 4.5 sones. Housing shall be insulated with minimum 1/2" acoustic insulation.
1. Accessories (as indicated on plans and schedules).

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Examine areas and conditions under which fans are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FANS

- A. General: Except as otherwise indicated or specified, install ventilators in accordance with manufacturer's installation instructions and recognized industry practices to ensure that ventilators serve their intended function.
- B. Coordinate ventilator work with work of roofing, walls and ceilings, as necessary for proper interfacing.
- C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Verify proper rotation direction of fan wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- D. Install vibration isolation as scheduled and specified in Section 23 20 00.

3.3 FIELD QUALITY CONTROL

- A. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.4 SPARE PARTS

- A. General: Furnish to Owner, with receipt, one spare set of belts for each belt drive power ventilator.

END OF SECTION

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SECTION 23 82 50
ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of energy recovery ventilation equipment work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of energy recovery ventilation equipment required for project include the following:
 - 1. Static plate enthalpy recovery type
- C. Refer to other Division 23 temperature control system sections for control work required in conjunction with energy recovery ventilator equipment.

1.2 RELATED DOCUMENTS

- A. Applicable provision of Division 1 governs work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 90 Testing, Adjusting and Balancing
 - 2. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. NFPA 90A
 - 2. CSA 22.2
 - 3. UL 1812
 - 4. AMCA 210
 - 5. ASHRAE 84-78P
 - 6. ARI 1060 standards
- B. UL Compliance: Provide air distribution equipment electrical components, which have been listed and labeled by Underwriter Laboratories (UL).
 - 1. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting
 - 2. NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
 - 3. Unit shall be Listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. Some exceptions to UL Listing may apply.

- C. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.

1.4 WARRANTY

- A. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase.
- B. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

1.5 SUBMITTALS

- A. Refer to division 1, General Conditions, Submittals.
- B. Submit shop drawings for all equipment including all data concerning dimensions, air flow capacities, sound ratings, heat recovery performance and appropriate identification.

PART 2 - PRODUCTS

2.1 AIR-TO-AIR HEAT EXCHANGERS (Static Plate Enthalpy Recovery Type)

A. MANUFACTURERS:

1. Oxygen 8.
2. Approved equal.

B. GENERAL: Indoor draw-through energy recovery unit consisting of a static plate enthalpy heat exchanger, ventilation air supply fan and exhaust air fan, unit electrical wiring and related control wiring

C. Unit Cabinet: Cabinet shall be double-walled constructed of 20-gauge G90 galvanized steel, insulated with minimum Rv8 foam insulation. The working components shall be fully accessible by hinged access doors.

D. HEAT EXCHANGER CORE: Enthalpic heat exchanger core shall consist of laminar flow, fixed-media, cross-flow construction with no moving parts. Latent energy transfer shall be accomplished by direct water vapor transfer through molecular transport. Exhaust and fresh air streams shall be separated and not mix. Heat exchanger core shall not require defrost control or condensate removal.

1. The ERV core shall perform without condensing or frosting under normal

operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

- E. FANS: Fans shall be DWDI forward-curved, ECM or VRD direct-driven with internal vibration isolation. Unit shall be constant volume air units operating at the specified external static pressure.
- F. MOTORS: Motors shall have characteristics consistent with the torque and speed of the fans being driven. All motors shall be NEMA frames and be rated in accordance with NEMA performance standards for continuous full load performance at 40 degrees C temperature rise above ambient, with a 1.15 service factor. Motor horsepower and voltages shall be as scheduled.
 - 1. The motor furnished with the fan shall not operate into the motor service factor.
 - 2. Furnish NEMA EPACT premium-efficiency motors.
 - 3. Furnish ECM controlled motors, where scheduled, allowing for to preset speeds or variable speed operation with a 0-10 volt DC control signal, where scheduled on the Drawings.
- G. FILTERS: Furnish 2" pleated MERV 8 filters and filter track on both entering air sides of unit. Filter rack may be integral with unit or installed independently in duct upstream of unit.
- H. CONTROLS: All unit controls shall be factory wired so that only field connections are required. Unit shall provide terminal connections for fan interlock with air handling unit operation and dirty filter signal.
 - 1. IBC - Independent Blower Control: Provide dual fan contactors for independent supply and exhaust fan control for economizer operation.
 - 2. Provide 24 volt control relay-transformer for 208-volt/3-phase service.
- I. ELECTRICAL: Single point power connection.
 - 1. Electric Service: 208-volt, 3-phase; as scheduled on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units in accordance with unit manufacturer's installation requirements in locations indicated on the drawings and as detailed.

3.2 ENERGY RECOVERY VENTILATORS

- A. Support or suspend the unit with proper mounting arrangement and connect with flexible duct connections.

- B. Coordinate low-voltage controls with the Temperature Control Contractor.
- C. Verify unit and fan controls are operating properly. Interlock unit operation with associated air handler for occupied ventilation operation.
- D. Confirm fan is operating in the correct rotation. Verify filters and cores are installed properly. Arrange for filter gauges and related accessories to be installed.
- E. Coordinate ERV final balance work the TAB Contractor.

END OF SECTION

SECTION 23 84 00 DUCTWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of ductwork requirements is indicated on the Drawings and by requirements of this section.
- B. The ductwork requirements for this project include the following:
 - 1. Low-Pressure Ductwork
 - 2. High-Pressure Ductwork
 - 3. Plenums
 - 4. Flexible Ductwork.
 - 5. Acoustic Duct Lining.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 25 00 Mechanical Insulation
 - 2. 23 86 00 Ductwork Accessories

1.3 QUALITY ASSURANCE

- A. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards" 3rd edition 2005 for fabrication and installation of metal and flexible ductwork.
 - 1. Duct Leakage Standards: HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012.
 - 2. HVAC Systems - Duct Design: 4th Edition, 2006
- B. ASHRAE Standards: Comply with ASHRAE Handbook and Product Directory, 1979 Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of ductwork.
- C. NFPA Compliance: Comply with ANSI/NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."
- D. ACIGH Industrial Ventilation 24th Edition 2001.

1.4 SUBMITTALS

- A. Submit product data and specifications for ductwork materials.
- B. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for low and high-pressure and exhaust ductwork systems.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.
- B. Offsite storage agreements do not relieve the contractor from using proper storage techniques.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

- A. Above ground, general ductwork: Galvanized steel, lock-forming quality, ASTM A527; 1.25 oz. zinc coating each side, mill phosphatized, ASTM A525.
 - 1. Round – Spiral wound ductwork.
- B. Steel Ducts: Galvanized steel, lock-forming quality, ASTM A527; 1.25 oz. zinc coating each side(G90), mill phosphatized, ASTM A525.
- C. Stainless Steel Ducts: ASTM A167, Type 304.
- D. Flexible Duct:
 - 1. Spiral wire Reinforced Fabric: Spiral wire reinforced fabric type flexible duct shall be made of a corrosion-resistant reinforcing wire helix bonded to a continuous layer of fabric. Class I Air Duct Material, UL Standard 181.
- E. Insulated Flexible Duct: Insulation shall be cellular glass, 1-1/2" nominal thickness of 1-1/2 pound density per cubic foot. The insulation shall encase the flexible duct and shall be sheathed with vapor barrier having a permeability of not over 2.0 perm. Insulation and vapor barrier shall be factory installed.
- F. Flexible Fiberglass Duct Liner: Flexible coated glass fiber duct liner; ANSI/ASTM C553; 'K' value of 0.26 at 75 degrees F; 1-1/2 lbs./cu. ft. minimum density; coated air side for maximum 4,000 ft./min. air velocity.
 - 1. Lagging Adhesives: Fire resistive to ASTM E84, NFPA 255.
 - 2. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad or mechanical fastener type as recommended, insulation manufacturer.
- G. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant gaskets and tapes as compounded and recommended by the manufacturer specifically for sealing joints and seams in ductwork.
- H. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
- I. Drive Screws and Clamps: As recommended by SMACNA.

- J. Factory Made Joints: Ductmate system as manufactured by Ductmate Industries, Inc., Nexus system as manufactured by Exanno, or other approved product may be used.

2.2 DUCTWORK PRESSURE-VELOCITY CLASSIFICATION

- A. General: Construct ductwork in conformance to SMACNA "HVAC Duct Construction Standards" 1st edition 1985.

B. Low Pressure Ductwork:

1. Static Pressure Class: +2" W.G.
2. Maximum Velocity Level: 2500 FPM.

C. High Pressure Ductwork:

1. Static Pressure Class: +4" W.G.
2. Maximum Velocity Level: 4000 FPM.

2.3 DUCTWORK SEALING CLASSIFICATION

- A. General: Construct ductwork in conformance to SMACNA "HVAC Duct Construction Standards" 1st edition 1985.

B. Low Pressure Ductwork:

1. Seal Class: B seal transverse joists and longitudinal seams.

C. High Pressure Ductwork:

1. Seal Class: A seal transverse joints and longitudinal seams and ductwall penetrations.

2.4 FABRICATION

- A. Shop fabricate ductwork in 4, 8, 10, or 12 foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembling and coordinated installation.
- B. All dimensions indicated on drawings are free area ductwork requirements. Increase ductwork dimensions to accommodate ductwork lining requirements.
- C. Accessories:
1. Fabricate ductwork with accessories such as air turns, extractors, and volume dampers, installed during fabrication to greatest extent possible.
 2. Fabricate ductwork with duct liner in each section of duct where required.
- D. Variation: No variation of duct configuration or sizes permitted except by written permission.
- E. Directional Change:

1. Construct tees, bends, and elbows with radius minimum 1-1/2 times width of duct on center lines.
2. Where not possible and where rectangular elbows used, provide airfoil type turning vanes.
3. Where acoustical lining is required, provide turning vanes of perforated metal type with fiberglass inside.

F. Size Change:

1. Increase duct sizes gradually, not exceeding 15 deg. divergence wherever possible.
2. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.

G. Seams and Joints:

1. Seams and joints fabricated in accordance with SMACNA standards.
2. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so not to breathe, rattle, vibrate, or sag.

2.5 LOW PRESSURE DUCTWORK

- A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on center line. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
1. Where acoustic lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- E. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- F. Connect flexible ducts to metal ducts with adhesive and draw bands.
- G. Round Duct Take-Offs: Provide conical or bellmouth low-pressure fittings.
- H. Square Duct Take-Offs: Provide 45 degree leading edge at square take-off with 4: minimum depth.

2.6 HIGH PRESSURE DUCTWORK

- A. Fabricate and support in accordance with SMACNA High Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.
- C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
- D. Fabricate continuously welded medium and high pressure round and oval duct fittings as indicated in SMACNA Standard. Joints shall be minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- E. Round or flat oval type ducts shall be constructed with lock tight spiral seams, gored elbows with centerline radius of 1-1/2 times the duct diameter and male/female fittings.
- F. Take-Offs: Conical tees, conical 45 degree laterals, conical bellmouth taps and fittings shall be used. Seal all joints airtight with gaskets and mastic sealants.
- G. Fabricated rectangular ducts shall be constructed with companion angle flanged joints secured to duct walls. Use continuous closed cell gasket at joints with snap-on cleats and corner bolts. Provide 45-degree close openings at takeoffs and corners. Seal all joints air tight with gaskets and mastic sealants.

2.7 DUCTWORK APPLICATION SCHEDULE

	<u>Air System</u>	<u>Classification</u>	<u>Material</u>
A.	Supply air - AHU's to VAV boxes:	High Press	Steel
B.	Return air - to AHU's:	Low Press	Steel
C.	Supply air - VAV boxes to outlets:	Low Press	Steel
D.	Exhaust air:	Low Press	Steel
E.	Fresh air:	Low Press	Steel

2.8 ACOUSTIC DUCT LINING APPLICATION SCHEDULE

	<u>Air System</u>	<u>Thickness</u>
A.	Transfer Ducts - Square or rectangular:	1"

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble and install ductwork in accordance with SMACNA standards, and which will achieve airtight and noiseless systems, capable of performing each indicated service.
 - 1. Align ductwork accurately at connections.
 - 2. Support ducts rigidly with suitable ties, braces, hangers and anchors of type, which will hold ducts straight, plumb and free of sags and vibration.

- B. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.
- C. Metal Duct Support:
1. Support ductwork from building structure as required and, where not otherwise indicated, anchor with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps or special beam clamps.
 2. Support vertical ducts, at 12 foot spacing, by attachment to adjacent vertical structural surfaces or by direct bearing at floor penetrations and similar locations.
 3. Support horizontal ducts located against structural walls and other similar adjacent vertical surfaces, at 8 foot spacing for ducts up to 40 inches horizontal dimension and 4 foot spacing for larger ducts.
 4. Hang horizontal rectangular ducts from overhead structure, at 10 feet spacing for duct widths up to 60 inches and 8 foot spacing for larger ducts.
 5. Arrange hangers, supports and duct rests to permit free, unrestrained and noiseless expansion and contraction of duct.
 6. Where duct lining not used, vertical members may be fastened to duct sides with sheet metal screws.
 7. Where duct lining is used, do not puncture sheet metal.
- D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Slope underground ducts to plenums or low pumpout points at 1:100 feet. Provide access doors for inspection.
- G. Connect terminal units to high-pressure ducts directly with three-foot maximum length of flexible duct. Do not use flexible duct to change direction.
- H. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout.
- I. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- J. Provide sleeved opening where ducts pass through smoke, fire and sound walls.
1. Seal space between duct and sleeve airtight with mineral wool or approved fire stopping material.
 2. Provide duct flange to cover and retain fire-stopping material.
- K. Connections:
1. Connect duct to equipment with flexible fabric, sheet metal clips, screws and washers.

2. Connect branch take-offs to include prefabricated air scoops formed of same material as associated duct system.
3. Connect diffusers or plenum boots to low-pressure ducts with 10-foot maximum length of flexible duct, held in place with strap or clamp.

L. Flexible Ductwork:

1. Do not exceed 6 feet in length in accordance with NFPA 90.
2. Install flexible ductwork with minimum offsets and trim.
3. Connect with factory-installed compression coupling each end or provide separate adjustable bond and clamp to secure duct to trunk fitting and to distribution unit fitting.
4. Where recommended by manufacturer, make connections with mastic duct tape and adjustable clamp.

3.2 DUCT LEAKAGE

- A. Inspect all ductwork for leak sources and repair.
- B. Do not insulate ductwork until it has been accepted for duct leakage.
- C. Refer to Section 23 05 90 for Testing, Adjusting, and Balancing requirements of ductwork system.
- D. Low pressure ductwork leakage rate shall not exceed 5%.
- E. High pressure ductwork leakage rate shall not exceed 2%.

END OF SECTION

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**SECTION 23 86 00
DUCTWORK ACCESSORIES**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of duct accessories work is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of duct accessories required for this project include the following:
 - 1. Dampers:
 - a. Manual dampers
 - b. Control dampers
 - 2. Fire dampers
 - 3. Turning vanes
 - 4. Duct hardware
 - 5. Duct access panels
 - 6. Flexible connections
 - 7. Duct Silencers

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 25 00 Mechanical Insulation
 - 2. 23 84 00 Ductwork
 - 3. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association SMACNA "HVAC Duct Construction Standards" 1st edition, 1985.
- B. Industry Standards: Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE) recommendations pertaining to construction of duct accessories, except as otherwise indicated.
- C. UL Compliance: Construct, test, and label fire dampers in accordance with Underwriters Laboratories (UL) Standard 555 "Fire Dampers and Ceiling Dampers".
- D. NFPA Compliance: Comply with applicable provisions of ANSI/NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of duct accessories.

PART 2 - PRODUCTS

2.1 DAMPERS

- A. Manual Dampers: Provide dampers of single blade type (up to 6" height) or multiblade type (over 6" height), constructed in accordance with SMACNA Standards. Provide damper operator with locking devices and damper position indicator.
- B. Automatic Control Dampers (ACD): Refer to Division 15900C section "Controls and Instrumentation" for automatic control damper requirements. Furnished by Temperature Controls Contractor.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dampers which may be incorporated in the work include, but are not limited to the following:
 - 1. Honeywell.
 - 2. Vent Products
 - 3. Ruskin Mfg. Co.

2.2 FIRE DAMPERS

- A. Fire Dampers: Provide 1-1/2 hour, Type 'B' UL listed fire dampers, of sizes indicated, unless indicated otherwise. Construct casing of 16 ga. galvanized steel with bonded red acrylic enamel finish. Provide fusible link as required. Provide damper with positive lock in closed position, and with the following additional features:
 - 1. U.L. Listed Fire Rating: 1-1/2 hour
 - 2. Damper Blade Assembly: Curtain type.
 - 3. Blade Material: Steel, match casing.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and smoke dampers which may be incorporated in the work include, but are not limited to the following:
 - 1. Air Balance Inc.
 - 2. Safe Air Inc.
 - 3. Ruskin Mfg. Co.

2.3 TURNING VANES

- A. Manufactured Turning Vanes: Provide turning vanes constructed of 1.5" wide curved blades set at 1.5" spacing O.C., supported with bars perpendicular to blade set at 2" O.C., and set into side strips suitable for mounting in ductwork. Double wall type turning vanes shall be 2" radius, 2-1/8" spacing O.C.
 - 1. Ducts over 24-inch dimension shall use double-wall airfoil type turning vane.
 - 2. Ducts with air velocity over 2500 FPM shall use double-wall airfoil type turning vane.
- B. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusions with perforated faces and fiberglass fill.
 - 1. Provide where acoustic duct liner is required.

2.4 DUCT HARDWARE

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct hardware which may be incorporated in the work include, but are not limited to the following:
1. Ventfabrics, Inc.
 2. Young Regulator Co.

2.5 DUCT ACCESS PANELS

- A. General: Provide where indicated, duct access panels of size indicated. Minimum size 12" x 12". Access panels are required at the following equipment, but are not limited to these locations:
1. Upstream and downstream of reheat or duct-mounted coils.
 2. Fire Dampers.
 3. Backdraft and motorized dampers.
 4. Automatic Control Dampers - internally mounted.
 5. Louvers.
- B. Construction: Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one (1) handle-type latch for doors 1/2" high and smaller, 2 handle-type latched for larger doors.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access door which may be incorporated in the work include, but are not limited to the following:
- 1 Air Balance Inc.
 - 2 Duro Dyne Corp.
 - 3 Ruskin Mfg. Co.
 - 4 Ventfabrics Inc.

2.6 FLEXIBLE CONNECTIONS

- A. General: Provide flexible duct connections, wherever ductwork connects to vibration-isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

2.7 DUCT SILENCERS

- A. General Requirements: Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.

1. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
 2. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges shall be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.
 3. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed except as noted in Section G below, to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
 4. All perforated steel shall be adequately stiffened to insure flatness and form. All spot welds shall be painted.
 5. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill, film liner, sealants, and acoustical spacer, shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- B. Silencers Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, minimum 22 gauge.
- C. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel.
1. Silencers: 26 gauge.
 2. Elbow Silencers: 22 gauge.
- E. Principal Sound-Absorbing Mechanism:
1. Dissipative silencers: provide with acoustic media of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin.
 2. Glass fiber density and compression shall be as required to insure conformance with laboratory test data.
 3. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly.
 4. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.
- F. Media Protection:
1. Dissipative silencers: Where indicated on the silencer schedule, media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which duct accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install duct accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA Standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 90 deg. elbows in supply and exhaust air systems, and elsewhere as indicated.
- C. Install access doors to open against systems air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- D. Coordinate with other work, including ductwork as necessary to interface installation of duct accessories properly with other work.
 - 1. Install control dampers provided by Temperature Control Contractor.
- E. Field Quality Control: Operate installed duct accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

END OF SECTION

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SECTION 23 87 00 AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Ceiling Diffusers
 - 2. Return & Exhaust Registers and Grilles

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 84 00 Ductwork
 - 2. 23 86 00 Ductwork Accessories

1.3 QUALITY CONTROL

- A. Manufacturers: Firms regularly engaged in manufacturer of outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Acceptable manufacturers are listed as follows:
 - 1. Carnes
 - 2. Titus
 - 3. Metal-Aire
 - 4. Krueger
 - 5. Price.
- B. ARI Standards: Comply with Air Conditioning and Refrigeration Institute (ARI) Standard 650 "Air Outlets and Inlets".
- C. ADC Standards: Comply with Air Diffusion Council standards.
- D. MCA Standards: Comply with Air Moving and Conditioning Association standards.

1.4 SUBMITTALS

- A. Submit shop drawings covering each item together with schedule of outlets and inlets.
- B. Submit manufacturer's air diffusion performance data and installation instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Except as otherwise indicated, provide manufacturers standard outlet and inlet products where shown, of size, shape, capacity and type indicated on schedules, constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide outlet and inlet products that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturers current data and schedule for application.
- C. Ceiling Compatibility: Provide outlet and inlet products with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.

2.2 CEILING DIFFUSERS

- A. Ceiling Diffusers: Face panel and blades shall be constructed of galvanized steel with exposed surfaces finished in off-white or as scheduled. Diffuser shall have horizontal directional blades for airflow, round or square neck with opposed blade damper. Adjustable vertical or horizontal hinged blades, where scheduled.
 - 1. Extruded aluminum construction.
- B. Diffuser is designed to mount over T-bar suspended or surface mounted in plaster ceiling systems.

2.3 PERFORATED CEILING GRILLES

- A. Perforated Square: Steel construction, perforated hinged face, T-Bar mounted, white finish with black interior. Square or round neck, as scheduled.

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

- A. Square and Rectangular: Steel or extruded aluminum construction, 40 degrees fixed deflection, surface-mounted.
 - 1. Opposed blade damper, as scheduled.
 - 2. Finish: White.
 - 3. Aluminum bar grilles, as scheduled.

2.5 SUPPLY REGISTERS

- A. Square and Rectangular: Aluminum construction, double-deflection, streamlined bars spaced 1/2" O.C., 1 1/4" margin, and gasket seals.
 - 1. Opposed blade damper, as scheduled.

2.6 LINEAR SLOT DIFFUSERS

- A. Insulated Plenum Slot Diffusers: Steel construction, insulated plenum with linear slot diffusers for 1 or 2-way throw at ceiling. T-bar mounted or surface mounted with flanged frame.
1. Opposed blade damper, as scheduled.
 2. Finish: White.
 3. Notched center for 48 inch diffusers, as scheduled.
 4. Provide center T-bar, as scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with other work, including ceiling layout, ductwork and ductwork accessories, as necessary to interface installation of air diffusers properly with other work.
- B. Install items in accordance with manufacturer's printed instructions.
- C. Paint ductwork visible behind air outlets matt black.
- D. Diffusers:
1. At each duct drop or take-off to individual diffusers, locate extractor or scoop.
 2. Support diffusers adequately for type of ceiling receiving diffusers.
 3. Adjust diffuser air pattern as required to provide draft less uniform air distribution.
- E. Grilles and Registers:
1. Secure overlapping frame of register or grille to screen, flange, or angle of ductwork with countersunk screws.
 2. Locate wall registers and grilles minimum 6 inches below ceiling, unless otherwise indicated.
 3. Locate separate accessible balancing volume damper at each register or grille in addition to control damper integral with register or grille.
 4. Adjust registers and grilles to provide draft less uniform air distribution.
- F. Louvers:
1. Coordinate required wall openings with other trades.
 2. Turn over louver to General Contractor for installation.
 3. Verify proper opening requirement with General Contractor.
 4. Caulking and waterproofing by General Contractor.

3.2 FIELD QUALITY CONTROL

- A. Test and operate installed outlets and inlets to demonstrate compliance with requirements.

END OF SECTION

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SECTION 23 89 50 VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Extent of variable frequency drive (VFD) equipment work is indicated by the Drawings and schedules, and by requirements of this section.
- B. Types of variable frequency drives required for this project include the following:
 - 1. Exhaust Fan VFD.
 - 2. Makeup Air Unit VFD.
 - 3. Air Handling Unit VFD.
- C. Variable Frequency Drives (VFD) shall be provided by the HVAC Contractor.
 - 1. The Variable Frequency Drives shall be supplied with the air handling unit for unit mounting and wired by the Electrical Contractor.
 - 2. The HVAC Contractor shall be responsible for providing VFD-compatible HVAC motors, where applicable.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
 - 1. 23 05 00 HVAC General Provisions
 - 2. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

- A. UL and NEMA Compliance: Provide products which have been listed and labeled by Underwriters Laboratories and comply with NEMA Standards.
 - 1. ANSI/UL Standard 508.
- B. IEEE and ANSI Compliance: VFD shall comply with applicable standards of IEEE, ANSI and NEC.
- C. Power Line Noise: Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of Static Power Converters. Distortion shall not exceed 5%.
- D. Radiated Noise: VFD shall not emit either conducted or radiated RFI in excess of limitations set forth in the FCC Rules and Regulations, Part 15, Subpart J.
- E. Installation and Start-Up Services: VFD manufacturer shall provide a factory trained engineer to approve the installation; start-up operations, test and adjust for proper

operations and instruct Owner's representative in the proper operation and maintenance of the units.

F. Warranty: Manufacturer shall provide standard 18-month warranty for VFD system parts and labor against defects in workmanship and material.

G. Acceptable Manufacturers:

1. ABB.
2. Danfoss.
3. Approved equal.

1.4 SUBMITTALS

- A. Submit shop drawings for all VFD and associated system components as herein specified including all data concerning dimensions, capacities and performance, wiring diagrams and appropriate identification.
- B. Submit certified efficiency versus load and speed curves for VFD.
- C. Submit certified electrical noise generation data in accordance with IEEE 519 standard. Submit electrical noise attenuation equipment required to meet criteria specified.
- D. Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Furnish complete variable frequency drives as specified herein for the fans and pumps, designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD enclosure shall be NEMA 1, freestanding or wall mounted.
- B. The VFD shall convert three-phase, 60-Hz utility power to adjustable-voltage and frequency, three-phase power for stepless motor speed control from 5% to 100% of the motor's 60-Hz speed. Input voltage shall be as specified on the Drawing schedules.
- C. The VFD shall include a converter and an inverter section. the converter section shall convert fixed frequency and voltage AC utility power to DC voltage. All VFDs shall include input line reactors.
- D. The inverter section of the VFD shall invert the DC voltage into a quality output waveform, with adjustable voltage and frequency for stepless motor speed control.
- E. The VFD and options shall be tested to ANSI/UL Standard 508. The Complete system, including all specified options, shall be listed by a nationally recognized testing agency such as UL or BTL.
- F. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of Static Power Converters. The total voltage distortion shall not exceed 5%.

- G. The VFD shall not emit radiated RFI in excess of the limitations set forth in the FCC Rules and Regulations, Part 15 for Class A computing devices. The VFD shall carry an FCC compliance label. PWM type drives shall include RFI filters.
- H. The VFD shall not cause objectionable acoustical motor noise. Motor noise as a result of the VFD shall be limited to three dB-over across-the-line operation, measured at three feet from the motors center line.
- I. The VFD's full load AMP rating shall meet or exceed NEC Table 430-150.
- J. Motors and variable frequency drives shall be provided by the drive manufacturer and selected to accommodate additional motor heating when driven by a VFD, while maintaining full nameplate horsepower at specified service factor.
- K. VFD system shall modulate the speed of its respective motor in response to a 0-10 VDC or 4-20 mA control signal provided by the Temperature Control Sub-contractor.
- L. VFD system shall consist of the following components:
 1. Variable frequency drive.
 2. Input disconnect switch.
 3. Electrical noise filter.

2.2 VFD UNIT

- A. General: VFD shall be variable torque, solid state transistorized control with diode bridge rectifier and manual transfer switch. The unit shall be U.L. listed, solid state, micro processor-based with a pulse width modulated (PWM) output wave form (none others are acceptable).
 1. The VFD shall employ a full wave bridge rectifier, to prevent line notching, with DC output bus choke, capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device.
 2. VFD shall be factory tested at maximum HP and 40 deg. C for 100 hours.
- B. Performance:
 1. Input Voltage: 460 volt, 3-phase, 60 Hertz.
 2. Output Voltage: 460 volt, 3-phase, 3 to 60 Hertz.
 3. Speed Range: 20:1 maximum.
 4. Enclosure: NEMA 1 with lock, wall mount.
 5. Minimum Efficiency: 92% @ 50%; 99% @ 100% speed.
 6. Power Factor: 0.95 thru speed range.
 7. Adjustments: Minimum and maximum speed acceleration-deceleration 30 to 50 seconds.
 8. Power Line Noise: Voltage distortion factor of 5% or less and a line notch depth of 25% or less.
- C. Standard Features:

1. Run/stop selector switch, auto/manual/bypass selector switch, fault light, manual speed potentiometer, power on light, ready light.
2. Speed/power/load digital display and selector switch.
3. Automatic under voltage reset with adjustable time delay.
4. 0-10 VDC or 4-20 mA common input signal follower.
5. Motor overload protection.
6. Over temperature protection.
7. Under voltage/over voltage protection.
8. Adjustable current limit.

D. Special Features:

1. Two N.C. and N.O. auxiliary contacts.
2. Input disconnect switch.

E. Provided devices to permit field adjustment of minimum and maximum output frequency.

F. Drives shall be equipped with devices allowing field adjustment of acceleration rate. Capability shall exist to allow motor speed to increase from start to full speed in a field adjustable period of time.

G. Provide one normally open and one normally closed auxiliary contact in each drive. These contacts shall be activated upon drive failure of any kind, including safety shutdowns. Contacts are intended to be used for remote monitoring of drive operation by the central energy management system.

H. Field performance testing of adjustable speed drive assemblies to determine compliance with specified performance requirements will be performed at the Owner's discretion. Performance testing may include any specified feature, including operation of protective devices (through simulated fault). The cost of initial testing will be borne by the owner. Should drive be found to be deficient in any performance category, drive manufacturer will be required to make any and all changes necessary to bring units into compliance with performance guidelines as specified. The cost of changes, and the cost of retest, will be borne by mechanical contractor.

PART 3 - EXECUTION

3.1 INSTALLATION OF VFD SYSTEM

A. Install VFD system in accordance with details, shop drawings and manufacturer's instructions.

B. VFD system components shall be turned over to the Electrical Trade for mounting and wiring under the supervision of the HVAC Contractor and Temperature Controls Sub-Contractor.

1. Field electrical wiring of line voltage components between transformer, VFD and motors shall be by the Electrical Trade.
2. Control wiring (100 volts or less) shall be by the Temperature Control Sub-Contractor.

C. Start-up, Operation and Maintenance:

1. Manufacturer shall provide the services of a factory-trained engineer to approve the installation, Start-up, test and adjust units for proper operation, and instruct and train the owner's maintenance personnel in the operation and maintenance of the units. Manufacturer's representative shall demonstrate operational capability of units during instruction and training period.
2. Upon completion of this service, submit to the Engineer a complete diagnostic report, including start-up and test log, signed by the manufacturer's representative.

END OF SECTION

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SECTION 23 90 00 CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Includes:

1. Complete system of Electronic Direct Digital Automatic Controls System.
2. Electrical Control system.
3. Control devices, components, wiring and material.
4. Instructions for users.

1.2 DESCRIPTION OF WORK

- A. Extent of controls and instrumentation work is indicated on drawings and schedules and by requirements of this section.
- B. New DDC control system with network wiring with Web-based remote access and central TC workstation for routine maintenance access to control network. Coordinate LAN security and access address with Owner's IT Contractor.
- C. Control system for rooftop units and variable volume boxes with space sensor and reheat coils shall be electronic (DDC) to control HVAC systems as specified herein. Electronic controlled devices such as valve and damper actuators shall be employed. Control loop logic and sequencing of HVAC operations shall be accomplished by DDC controls with electronic input devices as temperature and pressure sensors.
- D. Provide heating plant boiler reset, boiler enable, pump monitoring and control in conjunction with integrated boiler controls.
- E. Control systems shall be electronic DDC to control valve and damper actuators for terminal units, as specified herein.
- F. Provide duct-mounted smoke detector at AH-1 return ductwork
- G. Instruction of Owner's personnel.

1.3 RELATED WORK

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified Elsewhere:
1. 23 91 00 Direct Digital Control Systems
 2. 23 95 00 Control Sequence
 3. 23 95 10 DDC Point List

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Electrical Code, NEC
2. National Electrical Manufacturers Association, NEMA
3. Underwriter's Laboratories, UL

- B. All equipment provided, including control panels, dampers, valves, controllers, transmitters, sensors and other control devices shall bear the manufacturer's nameplate.
- C. Entire control system including piping and wiring shall be installed by mechanics specifically authorized by the Temperature Control equipment manufacturer for the installation and having acceptable experience installing and servicing similar control equipment.
 - 1. Temperature Control Contractor shall have a minimum of 5 years experience installing control systems.
 - 2. Contractor shall have authorized service personnel within 30 miles of the project.
- D. Acceptable Manufacturers:
 - 1. Honeywell.
 - 2. Approved equal control manufacturers.
- E. Guarantee: Guarantee the controls and instrumentation to maintain the temperature within one degree of the set point and further guarantee all work, materials, equipment, and controls against defects in workmanship and material, and provide service for a period of one (1) year from date of final acceptance.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. Schematic control diagrams giving specific data on all settings, ranges, action, adjustments, and normal positions.
 - 2. Wiring diagrams detailed adequately for field construction and include all related wiring.
 - 3. Control valve and damper schedules with complete sizing data giving required design flow and temperature or pressure, and any other pertinent data.
 - 4. Sequence of operation for each system corresponding to control schematics.
 - 5. Panel drawings including complete internal wiring and piping schematics and complete data on all mounted components.
 - 6. Damper operator schedule, listing quantity, size of operators and mounting arrangement.
 - 7. Space thermostat sensor schedule indicating types of covers and adjustment means for each space.
- B. Control Diagrams:
 - 1. Furnish and mount in each equipment room or space prints of schematic control diagrams and corresponding sequences of operation for all systems located therein.
 - 2. Diagrams and sequences mounted in frames under clear plastic and located in easily visible location or as directed by A/E.
- C. Product Data:
 - 1. Submit published descriptive data on each item of equipment and accessories.
 - 2. Submit manufacturer's installation instructions.
- D. Report:
 - 1. At completion of work, submit report of checkout of automatic control system.
 - 2. Report actual set points with record drawings.

1.6 CALIBRATION AND ADJUSTMENTS

- A. After completion of the installation, perform final calibrations and adjustments of the control equipment provided under this contract and supply services incidental to the proper performance of the automatic control system under warranty.
- B. Submit letter to Engineer indicating all controls are calibrated and operating per sequence of control.

1.7 SYSTEM START-UP AND ACCEPTANCE PROCEDURE

- A. Upon completion of the calibration, the Control Contractor shall start up the system and perform all necessary testing and run diagnostic tests to ensure proper operation. Control Contractor shall be responsible for generating all software and entering all databases necessary to perform the sequence of control and specified software routines. An acceptance test in the presence of the Owner's representative or engineer shall be performed.

1.8 OWNER TRAINING

- A. Provide sufficient but not less than 4 hours of training to the Owner's representatives, concerning the proper operation and maintenance of all control systems, sensing, monitoring and control equipment. Training sessions shall be conducted during normal business hours after system start-up and acceptance by the Owner.
- B. Submit operating and maintenance manuals to Owner a minimum of five (5) working days prior to training session. Use these manuals as the basis for instruction at all training sessions.
- C. Provide two follow-up visits for troubleshooting and instruction, one six months after substantial completion and the other at the end of the warranty period. Length of each visit to be not less than two (2) hours or the time necessary to provide required information and complete troubleshooting and inspection activity.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Factory shipping cartons for each piece of equipment. Factory-applied plastic end caps on each length of pipe and tube.
- B. Maintain cartons and end caps through shipping, storage and handling as required to prevent equipment and pipe-end damage, and to eliminate dirt and moisture from equipment and inside of pipe and tube.
- C. Where possible, store equipment and materials inside and protected from weather. When necessary to store outside, elevate well above grade and enclose with durable waterproof wrapping.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Provide complete control systems consisting of thermostats, sensors, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required

to operate mechanical system and to perform functions specified and in compliance with the sequence of operations described herein.

- B. Provide necessary materials, labor and field work necessary to connect control components factory supplied as part of equipment controlled.

2.2 COORDINATION OF TEMPERATURE CONTROL WORK

- A. Electric Wiring: All electric wiring in connection with the automatic temperature control system shall be furnished and installed by the Controls Trade, except for equipment starter interlocks, which are the responsibility of the Electrical Trade.
 - 1. All 120 (line) volt or larger electrical service wiring and connections to equipment and motor starters is the responsibility of the Electrical Trade.
 - 2. All additional line voltage power requirements beyond which is indicated on the Drawings and Specifications for the temperature control system shall be the responsibility of the Controls Trade.
- B. Valves and Piping Wells: Furnish by Controls Trade, installed by HVAC Trade under supervision.
- C. Dampers, Valves, Actuators and related Controlled Devices: Furnished by Controls Trade, installed by HVAC Trade under supervision.

2.3 CONTROL PANELS

- A. Provide local panels of unitized cabinet type for each system under automatic control. Mount relays, switches, and controllers with control point adjustment in cabinet and temperature indicators, pressure gages, pilot lights, push buttons, and clocks and switches flush on cabinet panel face. All components within the control panels shall be prewired to numbered terminal strips, ready for field connection to field-mounted control components.
- B. Control panels shall be constructed of steel or extruded aluminum with hinged door and keyed lock, with baked enamel finish of manufacturer's standard color.
- C. Mount panels adjacent to associated equipment on vibration free walls or free standing steel angle supports. One cabinet may accommodate more than system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

2.4 ELECTRICAL EQUIPMENT REQUIREMENTS

- A. Provide electrical devices and relays that are UL listed and of a type meeting current and voltage characteristics of the project.
- B. Duct Smoke Detector – Photoelectric:
 - 1. Provide intelligent photoelectric duct smoke detector at the locations shown on the drawings.
 - a. One form C auxiliary alarm relay rated at 2amps @ 30Vdc.
 - b. The operating range shall be 100ft/min to 4,000ft/min air velocity and temperature range of -20 to 158F.
 - c. Sample tube can be installed with or without the cover plate and be rotated in 45- degree increments to ensure proper alignment with duct airflow.
 - d. Local magnet-activated test switch.
 - 2. Provide remote test station with Alarm LED and Key Switch.

3. Relay Fan Shutdown: Rated to interrupt fan motor control circuit. Furnish and install separate device for each motor start. Connect to motor start as required for fan shutdown during alarm condition.

2.5 THERMOSTATS

A. Room Thermostats(Sensors):

1. Electronic Sensor Station: Single temperature sensor, modulating action, calibrated from 55-85 degrees F., two-piece construction with cover and sub-base with plug-in modular wiring harness.
2. Provide local adjustment with up/down push buttons and LCD readout of set point and space temperature at room thermostats (sensors).

B. Immersion Thermostats: For remote bulb elements use either averaging type or suitable length for air or rigid bulb type for liquids.

1. In liquids, use separable wells.
2. Duct thermostat sensing element shall be remote bulb or minimum 8 foot averaging element.
3. Thermostats shall be one or two-pipe, proportioning type, direct or reverse acting as required. Thermostat shall have adjustable set point and throttling ranges adequate for the application.

C. Outdoor Bulbs for Thermostats and Thermometers:

1. Locate on north side, with sun shield at least 10 feet above grade and at least 5 feet from openings.
2. Non-ferrous type securely fastened to construction.

2.6 FREEZESTATS (LOW-LIMIT CUT-OFF)

- A. Freezestats shall be of the electric 2-position type with temperature sensing element and manual reset. Stats shall be capable of opening the stat circuit if any one-foot length of the sensing element is subject to a temperature below the stat setting.
- B. Sensing element shall not be less than one lineal foot per square foot of coil surface area, minimum length 12 feet. Unless otherwise indicated, set freezestats at 38 deg. F.

2.7 SENSORS/TRANSMITTERS

- A. Temperature Sensors (Room): Use a surface mount zone temperature sensor housed in a durable ventilated plastic wall-mount enclosure, with broad aluminum faceplate. The sensing element to be a 1,000 ohm RTD (nickel or silicon) 0-10 VDC, or 4-20 MA accuracy +/- 1/2% span.
- B. Temperature Sensors (Discharge and Return Duct): Use a surface mount duct temperature sensor housed onto a standard metal handibox. The sensing element to be a 10,000-ohm RTD (nickel or silicon) 0-10 VDC, or 4-20 MA. House sensor in an 8-1/2" stainless steel probe. Accuracy +/- 1/2% span.
- C. Temperature Sensor (Mixed Air - Averaging): Select an averaging capillary type sensor housed on a standard metal handibox. The capillary type sensor to house no less than five sensing elements, which will return an average of the five or more sensor elements. The sensing elements are to be a 1,000-ohm RTD (nickel or silicon) 0-10 VDC, or 4-20 MA. Accuracy +/- 1/2% span.

- D. Immersion type temperature sensors: Rod and tube type with linear output. Provide separable thermo wells with heat conductive fluid for installation in pipeline. Units shall be factory calibrated.
- E. Ambient Static Pressure Sensor(reference): Equal to BAPI model ZPS-ACC-10 outside air pickup port or approved equal.

2.8 CONTROL VALVES

- A. Water Valves:
 - 1. Furnish all modulating straight-through water valves with equal-percentage contoured throttling plugs. Furnish all three-way valves with linear throttling plugs such that the total flow through the valve shall remain constant regardless of the valve's position.
 - 2. Size 3-way control valves for a pressure drop equal to the unit they serve but not to exceed 5 psi.
- B. Valves 2" and smaller shall be screwed type, forged or cast brass, 125 PSIG rated, stainless steel stems, synthetic elastomeric or teflon packing.
- C. 2-1/2" and larger valves shall be iron body, bronze mounted, stainless steel stems, PTFE teflon packing.

2.9 ELECTRIC CONTROL ACTUATORS

- A. Electronic Actuators shall be sized to operate their appropriate dampers or valves with sufficient reserve power to provide smooth proportional action or two-position action as specified.
 - 1. Modulating Valves: Valve actuators shall accept proportional 0-10 VDC or 0-20 mA signals for modulating action.
 - 2. Two-Position Valves: May be provided at radiation valves or convectors.
 - 3. Three-way Valves: Air handling unit water coils.
- B. Provide positive position sequencing relays for accuracy and non-overlapping operation of two or more actuators where required system design function.
- C. Actuators shall be designed to allow replacement of seal glands without draining the piping system.
- D. Acceptable Manufacturers: Belimo or approved equal.

2.10 NORMAL POSITIONS

- A. Regardless of type of system, each device shall assume specified normal positions on power failure.
- B. Normal positions shall be safe positions and as follows:
 - 1. Outside and Relief/Exhaust Air Dampers: Normally closed.
 - 2. Return Air Damper: Normally open.
 - 3. Automatic Control Valves: Normally open - full flow thru heat transfer device.
 - 4. Terminal Heating Valves: Normally open valve position; spring-return to full flow thru heat transfer device.

2.11 CONTROL DAMPERS

- A. The control trade shall furnish all control dampers as shown on the plans and/or as required to perform the control sequence specified except those furnished with fan equipment.
- B. All modulating dampers shall be sized by the control trade to meet flow requirements of the application in accordance with his recommendation. All two-position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than 90% of duct area.
- C. Unless otherwise indicated, all control dampers shall be opposed blade type. Two position dampers may be parallel blade type.
- D. All dampers shall be factory fabricated and shall be standard products of the control manufacturer.
- E. Damper frames shall not be less than 13 gauge galvanized steel or extruded aluminum of 12 gauge. Blades shall not be less than 16 gauge galvanized steel or 14 gauge aluminum, not over 8 inch width with steel trunnions mounted in a bronze sleeve or ball bearings.
- F. All blade linkage hardware shall have corrosion-resistant finish and be readily accessible for maintenance.
- G. Fresh and Relief Air Dampers: Furnish low-leakage type dampers with replaceable neoprene edging seals installed at all four sides of the fame and each blade.
 - 1. Dampers and seals shall be suitable for maximum temperature and air velocities to be encountered in the system with the minimum temperature ranges of -40 degrees F to 200 degrees F.
 - 2. Submit leakage and flow characteristic data for all control dampers along with shop drawings.
 - 3. Dampers when closed, shall be guaranteed by the control manufacturer not to leak air in excess of 1/2% at 4 inches static pressure water gauge.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all control equipment, wiring and air piping in a neat and workmanlike manner.
- B. All immersion wells, pressure tappings and any associated shut-off valves, flow switches, level switches and other such items furnished by the control manufacturer shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor.
- C. Install all control devices in an accessible location.
- D. Electrical Wiring: All electrical wiring for the automatic control system, excluding line voltage power to control panels, as indicated on the Drawings, shall be furnished and installed by the Temperature Control Contractor in accordance with this specification section. All the electrical sections of this specification and all applicable electric codes shall apply to the required work.

1. Sensor and/or control wiring shall be provided with conduit independent of those used for high voltage, switches AC or other signals which may create interference or cause induced voltages which promote signal drift or reduced accuracy. Sensor and high voltage wiring may not be run in the same conduit.

3.2 INSTALLATION

- A. Check and verify location of thermostats, room sensors and other exposed control sensors with plans and piping details before installation. Locate thermostats and sensors 60 inches above floor.
 1. Isolated from exterior walls as recommended by manufacturer.
 2. Located where not exposed to direct rays of sun, and where not influenced by concealed or adjacent heating, domestic hot water piping or warm air currents.
- B. Valve tops, inserts or bonnets, sensors, thermostats, thermometers, gauges, and damper motors of all types:
 1. Provide with access doors and/or access panels, in building construction so that they may be readily removed, replaced and serviced.
 2. Access doors and access panels by HVAC Contractor.
- C. Control Wiring of all Kinds:
 1. All control wiring to be labeled at both ends identifying termination and origination point.
 2. In conduit and included with temperature control system.
 3. Concealed low voltage control wiring may be routed as cabling.
 4. Exposed control wiring shall be in EMT conduit in mechanical areas or prefinished surface raceways in occupied areas. Submit surface raceway systems for prior approval before installation.
 5. Conforming to all requirements of Electrical Specifications, Division 16.
- D. Locate controls, relays, instruments, switches, valves, devices and accessories so they are readily accessible for adjustment, service, and replacement or as indicated on the drawings.
- E. Install control valves horizontal with power unit up unless otherwise indicated. Maximum variation from vertical is 45 degrees.
- F. Locate, size and support temperature sensing elements in water streams to properly sense the representative temperature.
 1. For controlling, transmitting and indicating elements, sensing device located, sized and of the type to sense the average condition.
 2. Wells shall not obstruct the flow of the fluid being measure.
 3. Pipes 1" and smaller shall be increased at least one pipe size at point of insertion.
- G. Where insulation on piping, ductwork or equipment is punctured or penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight.
- H. Where control devices are to be located on insulated surfaces, provide brackets to clear the finished surface of the insulation avoiding punctures of the vapor seal.
- I. Locate support, enclose and install control devices and equipment so that they will not be subject to:

1. Vibration
 2. Excessive temperatures
 3. Dirt, moisture or other harmful effects.
 4. Conditions beyond their rated limitations.
- J. Conceal all piping except piping in mechanical rooms and other areas where mechanical system piping may be exposed.
- K. Install all exposed piping and conduit parallel to or at right angles to the building structure and support adequately at uniform intervals. Use only tool made bends.
- L. Make tests on piping from time to time during the progress of installation to insure against leaks.

3.3 TESTING, ADJUSTING AND PERFORMANCE DEMONSTRATIONS

- A. All controlling devices which are a part of the automatic temperature control system, shall be tested and adjusted by the Contractor before system is offered for final acceptance.
1. All associated devices, valves, operators and dampers adjusted.
 2. All operating and positioning of all dampers verified.
- B. After all calibrations, adjustment and checking have been completed and all systems are operational:
1. Demonstrate to User's representative, the complete and correct functioning of all control systems and equipment.
 2. Demonstrations shall consist of operating the controls through their normal full ranges and sequences.
 3. Simulate abnormal conditions to demonstrate proper functioning of safety devices.
 4. Readjust all settings to their correct design values and after sufficient time, observe ability of controls to establish the desired conditions, noting any abnormal deviations.
 5. Make any necessary repairs, replacements or adjustments on all items which fail to perform satisfactorily, all to the satisfaction of the Owner's representative.
- C. Upon completion of the work and testing, but prior to final acceptance:
1. A representative of the control system manufacturer shall spend at least 4 hours or such length of time as necessary to instruct the Owner's personnel in proper operation, adjustment and maintenance of the control equipment and systems.
 2. Instruction shall be performed by competent, trained, full-time employees of the control system manufacturer who have a complete working knowledge of the systems and equipment installed in this job.
 3. Provide 4 hours follow-up visit within 3 months after completion to trouble-shoot and answer questions regarding the control system.

END OF SECTION

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**SECTION 23 91 00
DIRECT DIGITAL CONTROL SYSTEMS**

PART 1 - GENERAL

1.1 SCOPE

- A. The DDC control work associated with this section are part of the Temperature Control scope of the Work.
- B. The Building Automation System (BAS) shall be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.
- C. The Building Automation System (BAS) shall be a hardwired network with a server on the Owner's network LAN rack. All Building Management Functions shall be operable from a Web-based workstation.
- D. The BAS shall consist of the following:
 - 1. Interface with the Building Operator's Station.
 - 2. Direct Digital Control Panels.
 - 3. Standalone Application Specific Controllers (ACSs).
 - 4. BACnet Network Wiring.
 - 5. LAN/WAN Integration.
 - 6. Web Connection.
- E. Industry standard Open Communication Protocols shall be provided as specified in the applicable communication sections.
- F. BACnet compliance:
 - 1. The Building Management System (BMS) shall be operable on a BACnet bus.
 - 2. General Purpose Controllers, Unitary Controllers, Dedicated Equipment Controllers and PC-based workstations shall be able to operate and communicate on the 2-wire BACnet bus without the need of using gateways or drivers.
 - 2. The Systems Integrator shall after all hardware (devices/nodes and wiring) has been installed provide all necessary device installation, device configuration, device diagnostics, network variable binding and systems diagnostics.
- G. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASCs, and operator devices.
- H. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Specified elsewhere:
 - 1. 23 90 00 Controls and Instrumentation
 - 2. 23 95 00 Control Sequences
 - 3. 23 95 10 DDC Point List

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A firm specializing and experienced in DDC control system installation with a local service office within 30 miles of Madison, WI and experience with similar installations for no less than five (5) years. All work to be done by qualified mechanics in the direct employ of this manufacturer.
- B. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.
- C. DDC Standards: DDC manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with F.C.C. rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (1979 Amendment to Part 15, Subpart J).

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's specifications for each control device furnished, including installation instructions and startup instructions. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked.
 - 2. Annotated software program documentation shall be submitted for system sequenced, along with descriptive narratives of the sequence of operation of the entire system involved.
 - 3. Submit point-point wiring diagrams for each electrical control device with other details required to demonstrate that the system has been coordinated and will function as a system.
- B. Maintenance Data: Submit maintenance data and spare parts lists for each control device. Include this data in maintenance manual.
- C. Record Drawings: Prior to request for final payment, provide complete composite record drawings to incorporate the DDC and Pneumatic/Electric fieldwork

1.5 MATERIAL DELIVERY AND STORAGE

- A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

PART 2 - PRODUCTS

2.1 NETWORKING/COMMUNICATIONS

- A. The design of the BAS shall be networked as shown on the attached system configuration drawing. Inherent in the system's design shall be the ability to expand or modify the network either via a local network, auto-dial telephone line modem connections, or a combination of the two networking schemes.
- B. Building Operator's Station: Provided by Owner.

C. Local Network:

1. Building Operator's Station /Panel Support: The Building Operator's Station or Digital Panel shall directly oversee a local network such that communications may be executed directly to and between ASCs. The Operator's Terminal version or Digital Panel version shall be referred to as the "Digital Panel(s)" throughout this document.
2. Data Access: All operator devices either network resident or connected via dial-up modems, shall have the ability to access all point status and application data on the network. Access to system data shall not be restricted by the hardware configuration of the facility management system.
3. Global Data Sharing: global Data Sharing or Global point broadcasting shall allow point data to be shared between ASCs, when it would be inefficient or impractical to locate multiple sensors.
4. General Network Design: Network design shall include the following provisions:
 - a. Data transfer rates for alarm reporting and quick point status from multiple ASCs.
 - b. Support of any combination of ASCs. A minimum of 100 ASCs shall be supported on a single local network. The bus shall be addressable for up to 255 ASCs.
 - c. Detection of single or multiple failures of the ASCs or the network media.
 - d. Error detection, correction, and retransmission to guarantee data integrity.
 - e. Commonly available, multiple sourced, networking components shall be used.
 - f. Use of an industry standard protocol, such as IP, Optomux, and IEEE RS-485 communications interface.

D. The HVAC BAS provided under this section of the specifications shall consist of a distributed Client-Server, Local Area Network (LAN) based system, incorporating PC based Operator Workstations with dynamic multicolored graphic displays, a PC-based Server, a dedicated local area network, routers, switchers, network nodes, direct digital control system and software to provide interoperability with the server software. The system is to be furnished and installed in its entirety by this supplier.

E. The HVAC BAS shall be modular in design and scaleable in implementation from an initial installation of a single server with minimum of two concurrent operator workstations to a system with up to 40 concurrent operator workstations, unlimited web browser access (using Internet Explorer 6.0) to system information for monitoring and control functions, and field controller network interfaces to permit expansion to 60,000 physical hardware points.

2.2 DIGITAL PANELS

A. General: Digital Panels shall be microprocessor-based, multi-tasking, multi-user, digital control processors.

B. Memory: Each Digital Panel shall have sufficient memory to support its own operating system and databases including:

1. Control Processes
2. Energy Management Applications
3. Alarm Management
4. Trend Data
5. Maintenance Support Applications
6. Operator I/O
7. Dial-Up Communications
8. Manual Override Monitoring

- C. Expandability: The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators.
- D. Serial Communication Ports: Digital Panels shall provide at least two RS-232C serial data communication ports for simultaneous operation of multiple operator I/O devices such as laptop computers, Personal Computers, and Video Display terminals.
- E. Hardware Override Monitoring: Digital Panels shall monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
- F. Integrated On-Line Diagnostics: Each Digital Panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. The Digital Panels shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each Digital Panel.
- G. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- H. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of the Digital Panels to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery back up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
 - 1. Upon restoration of normal power, the Digital Panels shall automatically resume full operation without manual intervention.

2.3 SYSTEM SOFTWARE FEATURES

A. General

- 1. All necessary software to form a complete operating system as described in this specification shall be provided.
- 2. The software programs specified in this section shall be provided as an integral part of the Digital Panel and shall not be dependent upon any higher-level computer for execution.

B. Graphic Requirements: Provide color graphic backgrounds with operational information interface for the following systems:

- 1. Air Handler Unit AH-1, Relief Fan RF-1 and related.
- 2. Variable Volume Boxes with Reheat.
- 3. Boiler Heating Plant and Pumps.
- 4. Building Floor Plan graphic for temperature sensor information.

C. Control Software Description:

- 1. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.

2. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
3. Powerfail Motor Restart: Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.

D. Energy Management Applications: Digital Panels shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Demand Limiting
8. Load Rolling
9. Heating/Cooling Interlock
10. Average/High/Low Signal Select and Reset

All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the "Execution" portion of this specification.

E. Programming Capability: Digital Panels shall be able to execute configured processes defined by the user, to automatically perform calculations and control routines.

1. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:
 - a. Any system-measured point data or status
 - b. Any calculated data
 - c. Any results from other processes
 - d. Boolean logic operators (and, or,)
2. Process Triggers: Configured processes may be triggered based on any combination of the following:
 - a. Time of Day
 - b. Calendar Date
 - c. Other Processes
 - d. Events (e.g., point alarms)
3. Data Access: A single process shall be able to incorporate measured or calculated data from any and all other ASCs.

F. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each Digital Panel shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall the Digital Panel's ability to report alarms be affected by either operator activity at the local I/O device, or communications with other ASCs on the network.

1. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 60-character alarm message to more fully describe the alarm condition or direct operator response.
2. Each Digital Panel shall be capable of storing a library of at least 100 Alarm Messages. Each message may be assignable to any number of points in the panel.

3. Auto-Dial Alarm Management: In dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.
- G. Trend Analysis: A data collection utility shall be provided to automatically sample, store and display system data. Measured and calculated analog and binary data shall be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 24 hours, in one-minute or one-hour intervals, shall be provided. Each Digital Panel shall have a dedicated buffer for trend data, and shall be capable of storing 32 trend logs. Each trend log shall have up to 4 points trended at 168 data samples each. data shall be stored at the Digital Panel.
- H. Runtime Totalization: Digital Panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the "Execution" portion of this specification.
1. The Totalization routine shall have a sampling resolution of one minute.
 2. The user shall have the ability to define a warning limit for Runtime Totalization. Unique, user-specified messages shall be generated when the limit is reached.
- I. Event Totalization: Digital Panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.
1. The Event Totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.
 2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

2.4 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

- A. Each Digital Panel shall be able to extend its performance and capacity through the use of standalone Application Specific Controllers (ASCs).
- B. Each ASC shall operate as a standalone controller capable of performing its specific control responsibilities independently of other controllers in the network. Each ASC shall be of microprocessor-based, multi-tasking, real-time digital control processor.
- C. Each ASC shall have sufficient memory to support its own operating system and databases including:
1. Control Processes
 2. Energy Management Applications
 3. Operator I/O (Portable Service Terminal)
- D. The operator interface to any ASC point data or programs shall be through the Digital Panel or portable operator's terminal connected to any ASC on the network.
- E. ASCs shall directly support the temporary use of a portable service terminal that can be connected to the ASC via zone temperature or directly at the controller. The capabilities of the portable service terminal shall include, but not be limited to, the following:
1. Display temperatures
 2. Display status

3. Display set points
4. Display control parameters
5. Override binary output control
6. Override analog set points
7. Modification of gain and offset constants

F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.

1. Unitary Controllers:

- a. Unitary Controllers shall support, but not be limited to, the following types of systems to address specific applications described in the "Execution" portion of this specification, and for future expansion:
 - 1.) Unit Vents (ASHRAE Cycle I., II, III, or W)
 - 2.) Heat Pumps (Air-to-Air, Water-to-Air)
 - 3.) Packaged Rooftops
 - 4.) Fan Coils (Two-Pipe, Four-Pipe)
- b. Unitary Controllers shall support the following types of point inputs and outputs:
 - 1.) Economizer Switchover Inputs
 - a.) Drybulb
 - b.) Outdoor Air Enthalpy
 - c.) Differential Temperature
 - d.) Binary Input from a separate controller
 - 2.) Economizer Outputs
 - a.) Integrated Analog with minimum position
 - b.) Binary Output to enable self-contained
 - c.) Economizer Actuator
 - 3.) Heating and Cooling Outputs
 - a.) 1 to 4 Stages
 - b.) Analog Output with two-pipe logic
 - c.) Reversing valve logic for Heat Pumps
 - 4.) Fan Output
 - a.) On/Off Logic Control
- c. Unitary controllers shall support the following library of control strategies to address the requirements of the sequences described in the "Execution" portion of this specification, and for future expansion:
 - 1.) Daily Schedules
 - 2.) Comfort/Occupancy Mode
 - 3.) Economy Mode
 - Standby Mode/Economizer Available
 - Unoccupied/Economizer Not Available
 - Shutdown
 - 4.) Lighting Logic Interlock to Economy Mode
 - 5.) Temporary Override Mode
 - Temporary Comfort Mode (Occupancy-Based Control)
 - Boost (Occupant Warmer/Cooler Control)
- d. Alarm Management: Each VAV Terminal Unit Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

2. AHU Controllers

- a. AHU Controllers shall support, but not be limited to the following configurations of systems to address current requirements as described in the "Execution" portion of this specification, and for future expansion:

- 1.) Air Handling Units
 - Mixed Air-Single Path
 - Mixed Air-Dual Path
 - 100% Single Path
 - 100% Dual Path
 - b. AHU Controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion.
 - c. AHU controllers shall have a library of control routines and program logic to perform the sequence of operation as specified in the "Execution" portion of this specification.
 - d. Continuous Zone Temperature Histories: Each AHU Controller shall automatically and continuously, maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.
 - e. Alarm Management: Each AHU Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.
 - f. Each AHU Controller shall come with a hand-held Zone Terminal permanently mounted at the controller to allow interface with the controller. This device will allow the user to monitor or adjust set points and time scheduling within a specific zone.
3. Lab and Central Plan (LCP) Controllers:
- a. LCP controllers shall support, but not be limited to, the following configurations of systems to address current requirements described in the "Execution" portion of this specification, and for future expansion.
 - 1.) Single boiler or chiller plants with pump logic
 - 2.) Cooling towers
 - 3.) Zone pressurization of labs
 - 4.) Air Handling Units and Roof-top units with complex controls sequences
 - 5.) Plant Heating and Cooling circuits
 - 6.) Heat exchangers
 - b. LCP controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion. A minimum of 30 I/O points expandable to 94 shall be supported by the LCP.

2.5 OPERATOR INTERFACE

A. Basic Interface Description:

1. Command Entry/Menu Selection Process: Operator interface software shall minimize operator training through the use of English language prompting, English language point identification.
 - a. The operator interface shall have the option of using a mouse or similar pointing device for a "point and click" approach to facilities management. Users shall be able to start and stop equipment or change set points from graphical displays through the use of a mouse or similar pointing device.
2. Password Protection: Multiple-level password access protection shall be provided to allow the user/manager to limit control, display and database manipulation capabilities as he deems appropriate for each user, based upon an assigned password.
 - a. Passwords shall be exactly the same for all operator devices.
 - b. A minimum of four (4) levels of access shall be supported:

- c. A minimum of eight (8) passwords shall be supported at each Digital Panel.
 - d. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device, shall be limited to only those items defined for the access level of the password used to log-on.
 - e. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices logged on.
4. Operator Commands: The operator interface shall allow the operator to perform commands including, but not limited to, the following:
- a. Start-up or shutdown selected equipment
 - b. Adjust set points
 - c. Add/Modify/Delete time programming
 - d. Enable/Disable process execution
 - e. Lock/Unlock alarm reporting for each point
 - f. Enable/Disable Totalization for each point
 - g. Enable/Disable Trending

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the control system in accordance with manufacturer's instructions.

3.2 DEMONSTRATION

- A. The system manufacturer or his representative shall provide start-up and adjustment service for the control system.

END OF SECTION

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SECTION 23 95 00 CONTROL SEQUENCES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section 23 90 00 - Controls and Instrumentation, applies to the work of this section.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Refer to schematic layout of control and HVAC equipment on HVAC drawings.
- C. Specified Elsewhere:
- | | | |
|----|----------|--------------------------------|
| 1. | 23 90 00 | Controls and Instrumentation |
| 2. | 23 91 00 | Direct Digital Control Systems |
| 3. | 23 95 10 | DDC Point List |

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Section 23 90 00 - Controls and Instrumentation.

PART 3 - EXECUTION

3.1 CONTROL SEQUENCE

- A. Systems shall perform in accordance with the following descriptions of the control strategy intent.
- B. BAS = Building Automation System (DDC Controls).

3.2 OCCUPIED/UNOCCUPIED CONTROL

- A. Building Automation System (BAS) controls shall schedule occupied/unoccupied schedules for HVAC equipment.
- B. Provide occupied/unoccupied schedules for the following HVAC Equipment.
1. Air Handling Unit AH-1/RF-1.

3.3 HOT WATER CIRCULATION PUMPS P-1 & 1

- A. Lead pump shall be started by the BAS (Building Automation System) and shall operate continuously during the heating season. Pumps shall be switched for lead/lag operation automatically by the BAS, or by pumps failure, as sensed by differential pressure or current switches across the piping of the respective pump.
- B. Pump lead operation shall be manually rotated for equal run time by the BAS.

- C. Pump Capacity Control: Integral pump static pressure controller shall modulate pump capacity through signal to ECM motor speed controls to maintain constant setpoint pressure differential as scheduled.

3.4 BOILER CIRCULATION PUMPS P-4

- A. Interlock boiler pump shall be interlocked with the respective boiler control to operate with the boiler. Pumps shall be monitored for failure, as sensed by current switches.

3.5 HOT WATER HEATING SYSTEM

- A. Boiler manufacturer shall provide a microprocessor controller at each boiler and networked together to provide a tandem operating system as part of the integral boiler management system (BMS) at the master boiler control panel. The master boiler control panel shall be BACnet protocol compatible and provide a DDC control network connection.
- B. Hot water supply to the system shall be reset by outside air temperature with one sensor in the hot water supply to maintain a building hot water supply temperature and one sensor outside measuring ambient conditions as dictated by the following reset schedule:

<u>Outdoor Air Temperature</u>	<u>Hot Water Supply Temperature</u>
< 50 degrees F	160 degrees F
>= 50 degrees F	100 degrees F

- C. Two (2) modular boilers shall be staged and modulated into operation on a first-on/first-off basis to maintain a hot water supply temperature in the hot water buffer tank and HWS header as scheduled. Lead boiler selection shall be automatically rotated for equal run time on both boilers.
- D. HWS high limit alarm set at 200 degree F.
- E. The BAS controls shall be provided by the Temperature Control Contractor (TCC), the BACnet protocol controller at each boiler shall be provided by the boiler equipment supplier as part of the boiler equipment package. The boiler control system shall enable and disable boilers, sequence boilers, control each boiler capacity, optimize boiler plant efficiency, monitor and control hot water supply and return temperatures. The BAS controls shall access BACnet boiler system points and monitor boiler status through each boiler control communication interface (BACnet network).
- F. Temperature Control Contractor shall be responsible for mounting all Boiler Control Panel sensors and interfacing with the boiler representative upon boiler startup and control panel setup.

3.6 AIR HANDLER UNIT AH-1 (Multi-zone VAV)

- A. System consists of a draw-through single path air handling unit with variable volume supply fan, mixing box control dampers, 2-way control valve on hot water heating coil, two-stage DX cooling coil with modulating compressor capacity on one stage, relief fan and relief air control dampers on exhaust air stream.
- B. Furnish normally open two-way modulating automatic valve for the heating coil. Provide water-based freeze-stat control.
- C. Provide damper operators only for mixing box return/fresh air, and relief dampers mounted in factory air handling unit.

- D. Furnish filter section pressure drop monitoring and alarm signal.
- E. Occupied Mode: Supply fan SF-1 shall run continuously. Open fresh air dampers serving AH-1. Mixed air dampers shall be indexed to minimum fresh air position. Discharge air controller shall sequence economizer low-limit mixed air control, modulate 2-way hot water valve on the heating coil and sequence on two (2) stages of mechanical cooling with modulating (0-5 VDV) compressor capacity to maintain discharge air temperature setpoint (cooling only).
1. Discharge air temperature setpoint shall be reset by the BAS based on the most demanding VAV damper position (call for cooling).
 2. Reset range: 54 to 64 degrees F.
- F. Unoccupied Mode: Supply fan SF-1 will be deactivated with dampers and valves in normal positions.
1. If space temperatures drop below unoccupied setpoint with radiant floor; cycle air handler AH-1 with 100% return air and heating valve open to supplement heating requirements of spaces.
- G. Morning Warm-Up Mode: On morning warm-up cycle, supply fan SF-1 shall operate continuously with 100% return air. Hot water coil and reheat coil valves shall open 100% to supply heat to discharge air until return air temperatures reach a preset warm-up set point temperature.
1. Initial Warm-Up Set Point: 70 degrees F.
- H. VAV Supply Air Fan SF-1 Capacity Control: Static pressure controller with duct-mounted pressure sensor in main supply trunk shall modulate supply air fan volume through VFD motor speed controls to maintain minimum duct static setpoint in supply duct at sensor locations (2).
1. Initial Setpoint: 0.75" W.G. (adjustable). Provide digital electronic manometer at duct sensing location.
 2. High limit supply duct static pressure control set at 3.0" W.G. shall shut down supply fan and signal alarm with manual reset.
- I. Economizer Control: A low-limit mixed air dry bulb controller will sense tempered fresh air temperature and outside air temperature conditions and modulate mixing box dampers in sequence to maintain optimum mixture for discharge air setpoint conditions.
- J. Building Space Pressurization Control: Static air pressure controller with one reference sensor located outside the building on the roof and one (1) space sensors in the occupied space shall modulate relief damper open, start and sequenced relief air fan RF-1 through VFD motor speed controls to limit maximum space static pressure setpoint differential.
1. Initial Setpoint: positive (+) 0.08" W.G. (adjustable).
- K. Building Humidity Monitoring: Humidity sensor in the return air duct shall be used for monitoring and alarm purposes only.
- L. Demand Controlled Ventilation Control: A carbon dioxide sensor in the return air duct shall be used to reset minimum fresh air quantities higher upon carbon dioxide levels exceeding setpoint of 900 PPM (adjustable).

- M. Freeze Control: Low-limit immersion water sensor in the heating coil leaving water stream (HWR) shall upon sensing temperature below 35 degrees: Close fresh air damper, open heating coil valve 100%, shut down supply fan and energy recovery ventilator ERV-1 and move mixed air dampers to 100% return air. Signal local and BAS alarm with manual local reset and remote BAS reset.
- N. Smoke Detector: Smoke detector in the return air ductwork shall shut down supply fan, close fresh air damper and return mixing box dampers to 100% tempered fresh air position upon detection of products of combustion. Duct-mounted smoke detector shall be provided by the Electrical Trade (Fire Alarm System); associated interlock wiring to the temperature control panel and interlocks shall be provided by this Contractor. Signal local and BAS alarm with manual local reset.

3.7 VAV TERMINAL UNITS WITH REHEAT

- A. The VAV terminal units shall be individually controlled by a DDC VAV controller per VAV terminal unit. VAV box manufacturer shall provide flow ring with VAV box. The DDC controller, damper motor, and differential pressure transducer shall be supplied by the BAS Contractor and furnished to the terminal unit supplier for factory installation.
- B. The room sensor working through the pressure independent DDC controller shall modulate the box damper from minimum damper position and reheat coil valve to maintain discharge air setpoint at 70 deg F heating and 75 deg F cooling. Discharge air shall be reset by the space stat to satisfy the space conditions.
 - 1. Reset range 55 deg F - 100 deg F.
- C. Unoccupied: The reheat coil valve shall move to its 100% open position.
- D. Morning Warm-Up: The box damper and reheat coil valve shall remain in 100% open position.

3.8 EXHAUST FANS

- A. Exhaust Fan EF-X (3901 office area) shall run continuously in the occupied mode with AH-1.
 - 1. Motorized damper on discharge will open with EF activation.
- B. Exhaust Fans EF-1 is controlled by occupancy sensor and room light by Electrical Trade.

3.9 ENERGY RECOVERY VENTILATOR

- A. Energy Recovery Ventilator, ERV-3 shall run continuously in the occupied mode with FC-1.
 - 1. Motorized damper on FA and TEA will open with activation.

END OF SECTION

**SECTION 23 95 10
DDC POINT LIST**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Direct Digital Control (DDC) Point List.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Refer to schematic layout of control and HVAC equipment on HVAC drawings.
- C. Specified Elsewhere:
- | | | |
|----|----------|--------------------------------|
| 1. | 23 90 00 | Controls and Instrumentation |
| 2. | 23 91 00 | Direct Digital Control Systems |
| 3. | 23 95 00 | Control Sequences |

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Section 23 90 00 - Controls and Instrumentation.
- B. Refer to Section 23 91 00 - Direct Digital Control Systems.

PART 3 - EXECUTION

3.1 DDC POINT LIST

- A. Controls systems shall provide the DDC input/output control points and related as scheduled on the following sheets.

DDC POINT LIST					
POINT DESCRIPTION	TYPE	OPERATION SCHEDULE	ALARM	HISTORY	FIELD DEVICE
AIR HANDLING UNIT AH-1 & RELIEF FAN RF-1					
SF-1 FAN (AH-1)	DIGITAL OUTPUT	START/STOP	--	RUNTIME	RELAY @ VFD
SF-1 FAN (AH-1)	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
SF-1 VFD	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
AH-1 MA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-AHU
AH-1 FA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-DUCT
AH-1 RA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-DUCT
AH-1 CC TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-AHU CLG COIL
AH-1 DA	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	SENSOR-DUCT
AH-1 RA CO2 SENSOR	ANALOG INPUT	CO2 PPM	H/L	15 MIN.	CO2 SENSOR IN RA DUCT
AH-1 SD	DIGITAL INPUT	STATUS	SMOKE	15 MIN.	AUX. CONTACT @ SD
CU-1 STAGE 1	ANALOG OUTPUT	CAPACITY	--	15 MIN.	0-5 VDC SIGNAL MOD COMP
CU-1 STAGE 2	DIGITAL OUTPUT	START/STOP	--	15 MIN.	COMP RELAY
CU-1 CONDENSOR	DIGITAL OUTPUT	ENABLE/DISABLE	--	15 MIN.	CU CONDENSER RELAY
AH-1 FILTER APD	ANALOG INPUT	PRESS	H PRESS.	15 MIN.	DIFF. PRESS. SW.
AH-1 MA DPRS	ANALOG OUTPUT	MODULATE	--	15 MIN.	DAMPER ACTUATOR
AH-1 FA DPRS	BINARY OUTPUT	OPEN/CLOSE	--	15 MIN.	DAMPER ACTUATOR
HC-1 VALVE	ANALOG OUTPUT	MODULATE	--	15 MIN.	2-WAY VALVE ACTUATOR
HC-1 LOW LIMIT	ANALOG INPUT	TEMP	LOW TEMP	15 MIN.	HC-1 WATER FREEZESTAT
SA DUCT PRESS.	ANALOG INPUT	PRESS.	H/L PRESS.	15 MIN.	DUCT PRESS. SENSORS (2)
SA HL DUCT PRESS.	DIGITAL INPUT	PRESS.	HIGH PRESS.		HIGH LIMIT DUCT PRESS.
SPACE SP PRESS. DIFF	ANALOG INPUT	PRESS	H/L PRESS	15 MIN.	SPACE STATIC DIFF PRESS.
RF-1 FAN	DIGITAL OUTPUT	START/STOP	--	RUNTIME	RELAY @ VFD
RF-1 FAN	DIGITAL INPUT	STATUS	FLOW FAIL	--	CURRENT SENSOR
RF-1 VFD	ANALOG OUTPUT	FAN SPEED	--	15 MIN.	0-10 VDC SIGNAL
RF-1 EA DPR	ANALOG OUTPUT	MODULATE	--	15 MIN.	DAMPER ACTUATOR
VAV TERMINAL UNITS					
VAV BOX (TYPICAL EA.)	ANALOG INPUT	TEMP.	H/L TEMP	15 MIN.	SPACE SENSOR
VAV BOX (TYPICAL EA.)	ANALOG OUTPUT	MODULATE	--	15 MIN.	AIR VALVE ACTUATOR
VAV BOX (TYPICAL EA.)	ANALOG OUTPUT	MODULATE	--	15 MIN.	REHEAT HW VALVE ACTUATOR
VAV BOX (TYPICAL EA.)	ANALOG INPUT	AIR FLOW	H/L TEMP	15 MIN.	CFM OF VAV BOX
VAV BOX (TYPICAL EA.)	ANALOG INPUT	TEMP.	H/L TEMP	15 MIN.	ENTERING SA
VAV BOX (TYPICAL EA.)	ANALOG INPUT	TEMP.	H/L TEMP	15 MIN.	LEAVING SA

DDC POINT LIST					
POINT DESCRIPTION	TYPE	OPERATION SCHEDULE	ALARM	HISTORY	FIELD DEVICE
BOILER HEATING PLANT					
PUMP P-1	BINARY OUTPUT	START/STOP	--	RUNTIME	RELAY
PUMP P-1	ANALOG INPUT	INTERFACE	--	--	BACnet INTERFACE
PUMP P-2	BINARY OUTPUT	START/STOP	--	RUNTIME	RELAY
PUMP P-2	ANALOG INPUT	INTERFACE	--	--	BACnet INTERFACE
HWS TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - PIPE
BUFFER TANK HWS TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - TANK
HWR TEMP	ANALOG INPUT	TEMP.	H/L TEMP.	15 MIN.	IMMERSION SENSOR - PIPE
BOILER B-1	BINARY INPUT	ENABLE/DISABLE	--	RUNTIME	RELAY
BOILER B-1	ANALOG INPUT	INTERFACE	--	--	BACnet INTERFACE
BOILER B-2	BINARY INPUT	ENABLE/DISABLE	--	RUNTIME	RELAY
BOILER B-2	ANALOG INPUT	INTERFACE	--	--	BACnet INTERFACE

END OF SECTION

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**SECTION 23 96 00
STARTING OF MECHANICAL SYSTEMS**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Contractor:

1. Provide material and labor required for start up of all equipment and systems installed under general contract.
2. Coordinate start-up work with pipe cleaning, pipe system leak tests, and initial system fill and venting.
3. Provide all information and assistance required for cooperation with testing, adjusting and balancing services.
4. Contractor shall coordinate start-up of mechanical equipment with manufacturer's representative to be present for supervision and certification of correct operating procedures.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

- | | | |
|----|----------|----------------------------------|
| 1. | 23 05 90 | Testing, Adjusting and Balancing |
| 2. | 23 06 00 | Pipe and Pipe Fittings |
| 3. | 23 63 00 | Water Treatment |
| 5. | 23 89 50 | Variable Frequency Drives |
| 6. | 23 90 00 | Controls and Instrumentation |

1.3 START-UP PROCEDURES

A. Bearings:

1. Inspect for cleanliness, clean and remove foreign materials.
2. Verify alignment.
3. Replace defective bearing and those which run rough or noisy.
4. Lubricate as necessary in accordance with manufacturer's recommendations.

B. Motors:

1. Check each motor for amperage comparison to nameplate value.
2. Correct conditions, which produce excessive current flow, which exist due to equipment malfunction.

C. Drives:

1. Adjust tension in V-belt drives, and adjust vari-pitch sheaves and drives for proper equipment speed.
2. Adjust drives for alignment of sheaves and V-belts.
3. Clean and remove foreign materials before starting operation.

D. Pumps:

1. Check mechanical seals for cleanliness and adjustment before running pump.
2. Inspect shaft sleeves for scoring.
3. Inspect mechanical faces, chambers and seal rings; replace if defective.
4. Verify that piping system is free of dirt and scale before circulating liquid through pump.
5. Clean suction strainers.

E. Control Valves:

1. Inspect hand and automatic control valves, clean bonnets and stems.
2. Tighten packing glands to assure no leakage, but permit valve stems to operate without galling.
3. Replace packing on any valve, which continues to leak.
4. Remove and repair bonnets, which leak.
5. Coat packing gland threads and valve stems with surface preparation after cleaning.
6. Verify that control valve seats are free from foreign materials and are properly positioned for intended service.

F. Water Systems:

1. Tighten flanges after system has been placed in operation. Replace flange gaskets, which show signs of leakage after tightening.
2. Inspect screwed joints for leakage. Promptly remake each joint, which appears to be faulty; do not wait for rust to form.
3. After water system has been placed in operation, clean strainers, dirt pockets, orifices, valve seats and headers in fluid systems to assure being free of foreign materials.
4. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
5. Inspect each electrical control circuit to assure that operation complies with specifications and requirements to provide desired performance.
6. Inspect each pressure gauge and thermometer for calibration. Replace items defaced, broken or read incorrectly.
7. Repair damaged insulation.

G. Air Systems:

1. Set and calibrate draft gages of air filters and other equipment.
2. Replace filter media with new clean units.
3. Inspect fan wheels for clearance and balance. Provide factory-authorized personnel for adjustment when needed.
4. Check each electrical control circuit to assure that operation complies with specifications and requirements to provide desired performance.

H. Adjustments:

1. Provide such periodic continuing adjustment services as necessary to insure proper functioning of mechanical systems after occupancy of the Project, and for a period of one year after Date of Substantial Completion.
2. Note: Adjustment services are not maintenance services.

PART 2 - PRODUCTS

--- NOT USED ---

PART 3 - EXECUTIONS

--- NOT USED ---

END OF SECTION

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**SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 - GENERAL

The electrical work included in all other divisions is the responsibility of the contractor performing the division 26 work unless noted otherwise.

PROJECT OVERVIEW

The project consists of a renovation of the existing City of Madison buildings on Hanson Road in Madison, Wisconsin. The project areas will be entirely renovated with new lighting and power. The existing electrical panels in the buildings will remain to feed the new/revised loads in the project, as well as new additional panels will be added.

SCOPE

The work under this section includes basic electrical requirements, which are applicable to all Division 26 sections. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 - GENERAL

- Project Overview
- Scope
- Related Work
- Reference
- Reference Standards
- LEED Certification
- Commissioning
- Regulatory Requirements
- Quality Assurance
- Continuity of Existing Services and Systems
- Protection of Finished Surfaces
- Approved Electrical Testing Laboratories
- Sleeves and Openings
- Sealing and Fire Stopping
- Intent
- Omissions
- Submittals
- Project/Site Conditions
- Work Sequence and Scheduling
- Work by Other Trades
- Salvage Materials
- Certificates and Inspections
- Operating and Maintenance Data
- Record Drawings

PART 2 - PRODUCTS

- Access Panels and Doors
- Identification
- Sealing and Fire Stopping

PART 3 - EXECUTION

- Paintability
- Concrete Work
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Sleeves and Openings

- 1 Sealing and Fire Stopping
- 2 Housekeeping and Clean Up
- 3 Agency Training
- 4

5 **RELATED WORK**

6 Applicable provisions of Division 1 govern work under this Section.

7

8 **REFERENCE STANDARDS**

9 Abbreviations of standards organizations referenced in this and other sections are as follows:

- 10
- 11 ANSI American National Standards Institute
- 12 ASTM American Society for Testing and Materials
- 13 EPA Environmental Protection Agency
- 14 ETL Electrical Testing Laboratories, Inc.
- 15 IEEE Institute of Electrical and Electronics Engineers
- 16 IES Illuminating Engineering Society
- 17 ISA Instrument Society of America
- 18 NBS National Bureau of Standards
- 19 NEC National Electric Code
- 20 NEMA National Electrical Manufacturers Association
- 21 NESC National Electrical Safety Code
- 22 NFPA National Fire Protection Association
- 23 UL Underwriters Laboratories Inc.
- 24 DSPS Wisconsin Department of Safety and Professional Services
- 25

26 **LEED CERTIFICATION**

27 The project will be LEED Certified thru the United States Green Building Council's (USGBC) Leadership in Energy and
28 Environmental Design (LEED) program. Refer to Section 01 81 13 – Sustainable Design Requirements for additional
29 requirements.

30

31 In addition to complying with Division 26 drawings and specifications, equipment and material shall also comply with
32 Section 01 81 13 and LEED requirements.

33

34 The Division 26 contractor will be expected to provide all required documentation, submittals, etc. in accordance with
35 prerequisites and credits associated with Division 26 work and LEED Certification.

36

37 **COMMISSIONING**

38 The systems will be commissioned by an independent third party in accordance with USGBC LEED Energy and
39 Atmosphere Credit C3 – Enhanced Commissioning. Refer to Sections 01 91 0 – Commissioning and 01 95 01 –
40 Monitoring-Based Commissioning for additional requirements.

41

42 **REGULATORY REQUIREMENTS**

43 All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin State
44 Electrical Code (SPS 316), the National Electrical Code (NFPA 70), other applicable National Fire Protection Association
45 codes, the National Electrical Safety Code, and present manufacturing standards (including NEMA).

46

47 All Division 26 work shall be done under the direction of a currently licensed State of Wisconsin Master Electrician.

48

49 **QUALITY ASSURANCE**

50 Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or
51 engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs
52 involved in integrating the equipment or accessories into the system and the assigned space, and for obtaining the
53 performance from the system into which these items are placed.

54

55 Manufacturer references used herein are intended to establish a level of quality and performance requirements
56 unless more explicit restrictions are stated to apply.

57

1 All materials shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the
2 approved electrical testing laboratories has published standards for a particular item, then other national
3 independent testing standards, if available, applicable, and approved by City of Madison, shall apply and such items
4 shall bear those labels. Where one of the approved electrical testing laboratories has an applicable system listing and
5 label, the entire system shall be so labeled.
6

7 **CONTINUITY OF EXISTING SERVICES AND SYSTEMS**

8 No outages shall be permitted on existing systems except at the time and during the interval specified by the user
9 agency and by the City of Madison Project Representative. The institution may require written approval. Any outage
10 must be scheduled when the interruption causes the least interference with normal institutional schedules and
11 business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular
12 weekly working hours.
13

14 This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible.
15 Note that institutional operations are on a seven-day week schedule.
16

17 **PROTECTION OF FINISHED SURFACES**

18 Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up
19 paint with other "loose and detachable parts" as covered in the General Requirements.
20

21 **APPROVED ELECTRICAL TESTING LABORATORIES**

22 The following laboratories are approved for providing electrical product safety testing and listing services as required
23 in these specifications:
24

25 Underwriters Laboratories Inc.
26 Electrical Testing Laboratories, Inc.
27

28 **SLEEVES AND OPENINGS**

29 Refer to Division 1, General Requirements, Sleeves and Openings.
30

31 **SEALING AND FIRE STOPPING**

32 Sealing and fire stopping of sleeves/openings between conduits, cable trays, wireways, troughs, cablebus, busduct,
33 etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates
34 the opening. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance
35 with section 07 84 00 Fire Stopping.
36

37 **INTENT**

38 The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical
39 equipment and systems installation herein specified, except such parts as are specifically exempted herein.
40

41 If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the
42 inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the
43 Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits
44 the City's intent (as determined by the City of Madison Project Manager). Refer to the General Conditions of the
45 Contract for further clarification.
46

47 It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at
48 the site and be responsible for their accuracy.
49

50 All sizes as given are minimum except as noted.
51

52 Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject
53 at all times to the City of Madison's and/or A/E's inspections, tests and approval from the commencement until the
54 acceptance of the completed work.
55

56 Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and performance
57 requirements unless more explicit restrictions are stated to apply.
58

1 **OMISSIONS**

2 No later than ten (10) days before bid opening, the Contractor shall call the attention of the City of Madison to any
3 materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

4
5 **SUBMITTALS**

6 Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal
7 with that specification section number. Mark general catalog sheets and drawings to indicate specific items being
8 submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
9 Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission.
10 Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project
11 schedule.

12
13 On request from the City of Madison, the successful bidder shall furnish additional drawings, illustrations, catalog
14 data, performance characteristics, etc.

15
16 Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single
17 submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically
18 powered equipment.

19
20 The submittals must be approved before fabrication is authorized.

21 Submit sufficient quantities of submittals to allow the following distribution:

22	Operating and Maintenance Manuals	2 copies
23	User agency	1 copy
24	A/E	1 copy

25
26 **PROJECT/SITE CONDITIONS**

27 Install Work in locations shown on drawings, unless prevented by project conditions.

28
29 Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work
30 specified in other sections. Obtain permission of City of Madison before proceeding.

31
32 Tools, materials and equipment shall be confined to areas designated by the City of Madison.

33
34 **WORK SEQUENCE AND SCHEDULING**

35 Install work in phases to accommodate user agency's occupancy requirements. During the construction period
36 coordinate electrical schedule and operations with City of Madison's Construction Representative.

37
38 **WORK BY OTHER TRADES**

39 Every attempt has been made to indicate in this trade's specifications and drawings all work required of this
40 Contractor. However, there may be additional specific paragraphs in other trade specifications and addenda, and
41 additional notes on drawings for other trades which pertain to this trade's work, and thus those additional
42 requirements are hereby made a part of these specifications and drawings.

43
44 Electrical details on drawings for equipment to be provided by others are based on preliminary design data only. This
45 Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually
46 provided by others.

47
48 **SALVAGE MATERIALS**

49 No materials removed from this project shall be reused unless specifically noted otherwise. All materials removed
50 shall become the property of and shall be disposed of by the Contractor.

51
52 **CERTIFICATES AND INSPECTIONS**

53 Obtain and pay for all required installation inspections.

54
55 **OPERATION AND MAINTENANCE DATA**

56 All operations and maintenance data shall comply with the submission and content requirements specified under
57 section GENERAL REQUIREMENTS.

58

1 In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
2 documentation:

- 3 1. Manufacturer's wiring diagrams for electrically powered equipment.
4

5 **RECORD DRAWINGS**

6 The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.
7

8 The City of Madison will provide the Contractor with a suitable set of contract drawings on which daily records of
9 changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall
10 locate all buried or concealed piping, conduit, or similar items.

11
12 The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will
13 be permitted.
14

15 At completion of the project, the Contractor shall submit the marked-up record drawings to the Architect/Engineer
16 prior to final payment.
17

18
19 **PART 2 - PRODUCTS**
20

21 **ACCESS PANELS AND DOORS**

22 Lay-in Ceilings:

23 Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under other divisions are sufficient; no
24 additional access provisions are required unless specifically indicated.
25

26 **IDENTIFICATION**

27 See Electrical section 26 05 53 – Identification for Electrical Systems.
28

29 **SEALING AND FIRE STOPPING**

30 FIRE AND/OR SMOKE RATED PENETRATIONS:

31 Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section
32 07 84 00 "Fire Stopping".
33

34 NON-RATED PENETRATIONS:

35 Conduit and Cable Tray Penetrations:

36 At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above grade, use
37 urethane caulk in annular space between conduit and sleeve, or the core drilled opening.
38

39 **PART 3 - EXECUTION**
40

41 **PAINTABILITY**

42 Any/all electrical equipment, conduit, wiring, boxes, etc. that is to be exposed shall be painted to match the
43 architectural colors throughout the construction limits. Provide the appropriate finish on all electrical equipment,
44 conduit, wiring, boxes, etc. such that painting is possible. Coordinate all finish requirements with architectural
45 documents.
46

47 **CONCRETE WORK**

48 The Division 3 Contractor will perform all cast-in-place concrete unless noted otherwise elsewhere. Provide all layout
49 drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for
50 the support of electrical equipment.
51

52 **CUTTING AND PATCHING**

53 Refer to Division 1, General Requirements, Cutting and Patching.
54

55 **BUILDING ACCESS**

56 Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access
57 was not previously arranged and must be provided by this contractor, restore any opening to its original condition
58 after the apparatus has been brought into the building.

1 **EQUIPMENT ACCESS**

2 Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the
3 exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is
4 available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the
5 access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.
6

7 **COORDINATION**

8 The Contractor shall cooperate with other trades and City of Madison in locating work in a proper manner. Should it
9 be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general
10 installation, such work shall be done at no extra cost to the City of Madison, provided such decision is reached prior to
11 actual installation. The Contractor shall check location of electrical outlets with respect to other installations before
12 installing.
13

14 The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes,
15 but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed
16 in/on architectural surfaces.
17

18 Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that
19 interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
20

21 **SLEEVES AND OPENINGS**

22 Conduit penetrations in existing concrete floors: Core drill openings.
23

24 Where penetrating conduit weight is supported by floor, provide manufactured product or structural bearing collar
25 designed to carry load.
26

27 **SEALING AND FIRE STOPPING**

28 FIRE AND/OR SMOKE RATED PENETRATIONS:

29 Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section
30 07 84 00 Fire Stopping.
31

32 NON-RATED PENETRATIONS:

33 At all interior walls and exterior walls, conduit penetrations are required to be sealed. Apply sealant to both sides of
34 the penetration in such a manner that the annular space between the sleeve or cored opening and the conduit is
35 completely blocked.
36

37 PENETRATIONS SUBJECT TO WATER INTRUSION:

38 For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical
39 equipment (but not within walls) provide one of the following:

- 40 • Conduit penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
- 41 • Conduit penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above
42 the floor (provided it meets the device's UL listing).
- 43 • Conduit penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2"x
44 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to
45 prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten
46 angles to floor minimum 8" on center. Seal corners water tight with urethane caulk.
47

48 Floors subject to water intrusion or rooms housing electrical equipment include the following locations:

- 49 • Restrooms
- 50 • Janitor Rooms w/ Sinks
- 51 • Mechanical/Plumbing Equipment Rooms
- 52 • Data/Telecommunications Rooms
- 53 • Electrical Equipment Rooms
54

55 Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the fire
56 stopping system from water) in areas subject to wash down such as Food Service and Dish Washing Areas.
57
58

1 **HOUSEKEEPING AND CLEAN UP**

2 The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its
3 work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this
4 Contractor shall remove all tools, excess material and equipment, etc., from the site.

5

6 **AGENCY TRAINING**

7 Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations,
8 maintenance and troubleshooting of the system and/or components defined within this section for a minimum period
9 of 4 hours.

10

11

END OF SECTION

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**SECTION 26 05 02
ELECTRICAL DEMOLITION FOR REMODELING**

PART 1 - GENERAL

SCOPE

The work under this section includes the demolition associated with the renovation of the existing City of Madison buildings on Hanson Road in Madison, Wisconsin. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

PART 2 - PRODUCTS

Materials and Equipment

PART 3 - EXECUTION

Examination

Preparation

Demolition and Extension of the Existing Electrical Work

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS

MATERIALS AND EQUIPMENT

Materials and equipment for patching and extending work as specified in the individual Sections.

PART 3 - EXECUTION

EXAMINATION

Verify field measurements and circuiting arrangements as shown on Drawings.

Verify that abandoned wiring and equipment serve only abandoned facilities.

Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the User Agency, Architect/Engineer, and City of Madison Field Representative before disturbing existing installation.

Beginning of demolition means installer accepts existing conditions.

PREPARATION

Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

Coordinate utility service outages with the User Agency, City of Madison Field Representative, and Architect/Engineer. Also, if applicable, coordinate utility service outages with the local Utility Company.

Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations and follow the safe working practice requirements of NFPA 70E.

Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the City of Madison Field Representative at least 48 hours before partially or completely disabling system. Minimize outage duration. If required, make temporary connections to maintain service in areas adjacent to work area.

1 Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to
2 make switchovers and connections. Obtain permission from the City of Madison Field Representative and local
3 Authority Having Jurisdiction at least 48 hours before partially or completely disabling system. Minimize outage
4 duration. If required, make temporary connections to maintain service in areas adjacent to work area.
5

6 **DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

7 Remove, relocate, and extend existing installations as necessary, to accommodate new construction and to meet all
8 requirements of these specifications. Extend existing installations using materials and methods compatible with
9 existing electrical installations, or as specified.

10
11 Remove abandoned wiring to source of supply.

12
13 Remove exposed abandoned conduit and abandoned conduit above accessible ceiling finishes, unless noted
14 otherwise on drawings. Cut conduit flush with walls and floors, and patch surfaces. If certain conduits and boxes are
15 abandoned but not scheduled for removal, they shall be shown on the "As Built Drawings".
16

17 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit and wiring servicing them
18 is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
19

20 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
21

22 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
23

24 Provide revised typed circuit directory in panelboards that have circuits removed.
25

26 Repair adjacent construction and finishes damaged during demolition and extension work.
27

28 Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as
29 appropriate.
30

31 Provide supplemental support for conduits that are routed through demolition area and are to remain. Supplemental
32 support shall be added so that the conduit meets the support requirements of electrical specification section 26 05
33 33.
34

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END OF SECTION

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**SECTION 26 05 04
CLEANING, INSPECTION, AND TESTING OF ELECTRICAL EQUIPMENT**

PART 1 - GENERAL

SCOPE

The work under this section includes the required cleaning, inspection, adjustment, maintenance and testing of electrical equipment, as specified herein. This applies only to new electrical and existing electrical equipment being furnished, modified, worked on or serviced by this contractor for this project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work

PART 2 - PRODUCTS

- Not Used

PART 3 - EXECUTION

- General Inspection and Cleaning of All Electrical Equipment
- Grounding Systems
- Light Fixtures
- Occupancy Sensors

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS

- Not Used.

PART 3 - EXECUTION

GENERAL INSPECTION AND CLEANING OF ALL ELECTRICAL EQUIPMENT

Inspect for physical damage and abnormal mechanical and electrical conditions.

Any item found to be out of tolerance, or in any other way defective as a result of the required inspection or testing, shall be reported to the City of Madison. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed the item shall be re-tested.

Compare equipment nameplate information with the latest single line diagram and report any discrepancies.

Verify proper auxiliary device operation and indicators.

Check tightness of accessible bolted electrical joints. Use torque wrench method.

Make a close examination of equipment and remove any shipping brackets, insulation, packing, etc. that may not have been removed during original installation.

Make a close examination of equipment and remove any dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.

Clean All Equipment:

- Vacuum inside of panelboards, switchboards, switchgear, transformer core and coils, bus ducts, MCC's, fire alarm panels, communication/data panels, security panels, etc.
- Loosen attached particles and vacuum them away.
- Wipe all insulators with a clean, dry, lint free rag.
- Clean insulator grooves.

1 Inspect equipment anchorage.

2

3 Inspect equipment and bus alignment.

4

5 Check all heater elements for operation and control.

6

7 Lubricate nonelectrical equipment per manufacturer's recommendations.

8

9 **GROUNDING SYSTEMS**

10 Inspect the ground system for adequate termination at all devices.

11

12 **LIGHT FIXTURES**

13 Check the bonding and proper lamping. Verify that recessed fixtures are installed with hold down clips. Confirm
14 operation of the fixture with the proper switch or sensor.

15

16 **OCCUPANCY SENSORS**

17 Confirm operation of the sensor per the manufacturer's specification.

18

19

END OF SECTION

1 Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths
2 required.

3 4 **PART 2 - PRODUCTS**

5 6 **GENERAL**

7 All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of
8 manufacturer's stock.

9
10 All conductors shall be copper. All ground conductors shall be copper.

11
12 Insulation shall have a 600 volt rating.

13
14 All conductors shall be stranded.

15
16 Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g.
17 stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp
18 type device or must be terminated in an approved back wired method.

19 20 **BUILDING WIRE**

21 Description: Single conductor insulated wire 90 degree C.

22
23 Insulation: Type THHN/THWN-2, XHHW-2 insulation.

24 25 **WIRING CONNECTORS**

26 Split Bolt Connectors: Not acceptable.

27
28 Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment
29 terminals. Not approved for splicing.

30
31 Twist Type Wire Connectors: Solderless twist type spring connector (wire-nut) with insulating cover for copper wire
32 splices and taps. Use for conductor sizes 10 AWG and smaller. The manufacturer's wire fill capacity must be followed.
33 Use Silicone filled twist type spring connectors in all wet location areas.

34
35 Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled
36 cable entrances.

37
38 Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled
39 barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.
40 Connector must be installed with a crimper tool listed for use with the manufacturer and type of compression
41 connector.

42
43 Insulation Piercing Connectors: Molded insulated body, copper teeth, wrench tightened, UL 486B Listed. May be used
44 only for connection of a tap conductor in run and tap type applications when main conductor is 8 AWG and larger.

45 46 **PART 3 - EXECUTION**

47 48 **GENERAL WIRING METHODS**

49 All wire and cable shall be installed in conduit.

50
51 Do not use wire smaller than 12 AWG for power and lighting circuits.

52
53 All phase, neutral and ground conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity.
54 As a minimum use 10 AWG conductors for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m),
55 and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

56
57 Ground conductor size shall be increased per NEC 250.122(B) when phase and phase/neutral conductors are
58 increased in size.

- 1 Make conductor lengths for parallel conductors equal.
- 2
- 3 Splice only in junction or outlet boxes.
- 4
- 5 No conductor less than 10 AWG shall be installed in exterior underground conduit.
- 6
- 7 Identify ALL low voltage wire, 600V and lower, per section 26 05 53.
- 8
- 9 Neatly train and lace wiring inside boxes, equipment, and panelboards.

10

11 WIRING INSTALLATION IN RACEWAYS

- 12 Pull all conductors into a raceway at the same time. Use Listed water or silicone based wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary. Wax based lubricants are not allowed.
- 13 Pulling lubricant is not required for low friction type products where the cable manufacturer recommends that cables be pulled without lube.
- 14
- 15
- 16

17

- 17 Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- 18
- 19

20

- 20 Completely and thoroughly swab raceway system before installing conductors.
- 21

22

- 22 Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.
- 23
- 24
- 25

26

- 26 In high ambient spaces, mechanical rooms, utility rooms and exterior exposed conduit, 90 degree C, XHHW-2 conductors shall be utilized.
- 27
- 28

29

29 WIRING CONNECTIONS AND TERMINATIONS

- 30 Splice only in accessible junction boxes.
- 31

32

- 32 Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.
- 33
- 34

35

- 35 All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.
- 36
- 37

38

- 38 Use solderless twist type spring connectors (wire nuts) with insulating covers for wire splices and taps, 10 AWG and smaller.
- 39
- 40

41

- 41 Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the wiring.
- 42
- 43

44

- 44 Thoroughly clean wires before installing lugs and connectors.
- 45

46

- 46 At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.
- 47

48

48 FIELD QUALITY CONTROL

- 49 Field inspection and testing will be performed under provisions of Section 26 05 04.
- 50

51

51 WIRE COLOR

- 52 General:

53

- 53 Solid colored insulation is required for all THHN/THWN-2 wire. For other wire types use colored wire or identify wire with colored tape at all terminals, splices and boxes. Wire shall be colored as indicated below.
- 54
- 55

56

- 56 In existing facilities, use existing color scheme.
- 57

57

1 Switch legs shall be the same color as their associated circuit, except for the second switch leg used for
2 dual-level switching. The second switch leg shall be the next phase color, e.g. if the first switch leg is brown
3 (277/480V phase A), the second switch leg shall be orange (277/480V phase B).
4

5 Traveler conductors run between 3 and 4 way switches shall be colored pink or purple.
6

7 Neutral Conductors: White for 120/208V and 120/240V systems, Gray for 277/480V systems. Where there are two or
8 more neutrals in one conduit, each shall be individually identified with a different stripe.
9

10 Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.
11

12 Feeder Circuit Conductors: Each phase shall be uniquely color coded.
13

14 Ground Conductors: Green colored insulation for THHN/THWN-2 wire. For other wire types use green colored wire or
15 identify wire with green tape at both ends and at all access points, such as panelboards, motor starters, disconnects
16 and junction boxes. When isolated grounds are required, contractor shall provide green with yellow tracer.
17

18 **BRANCH CIRCUITS**

19 The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All single-phase branch
20 circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase
21 conductors.
22

23
END OF SECTION

1
2 All conductors shall be copper.
3
4 Insulation shall have a 600 volt rating.
5
6 All conductors shall be suitable for the application intended. Conductors #12 and smaller may be solid or stranded
7 with the following requirements or exceptions:
8
9 All conductors terminated with crimp type devices shall be stranded.
10
11 Stranded conductors shall be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded
12 conductors shall not be wrapped around a terminal screw but shall be terminated with a crimp type device
13 or in an approved back wired method.
14

15 **REMOTE-CONTROL AND SIGNALING CABLE**

16 All other systems cabling shall meet the requirements of NEC Article 725 and the following:

17
18 Cable for Class 1 Remote-Control, Signaling and Power-Limited Circuits: 600 volt insulation, individual
19 conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be Listed,
20 temperature rated, and suitable Type (general purpose, riser or plenum) for the application as required in
21 the National Electrical Code.
22

23 Cable for Class 2 or Class 3 Remote-Control, Signaling and Power-Limited Circuits shall be Listed,
24 temperature rated, and suitable Type (general purpose, riser or plenum) for the application as required in
25 the National Electrical Code.
26

27 **WIRING CONNECTORS**

28 Split Bolt Connectors: Not acceptable.

29
30 Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and
31 taps. Use for conductor sizes 10 AWG and smaller.
32

33 All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector
34 designed for damp and wet locations.
35

36 **PART 3 - EXECUTION**

37 **GENERAL WIRING METHODS**

38 Control-voltage cables shall be installed in conduit. However, they may be installed free-air (without conduit) above
39 accessible ceilings if the cable meets NEC requirements for the application, unless specified to be in conduit in other
40 sections of the specifications. See requirements for free-air cable installation below.
41
42

43 Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60
44 volts, all sizes subject to NEC 725 requirements.
45

46 Splice only in junction boxes.

47 Identify wire per section 26 05 53.

48 Neatly train and lace wiring inside boxes, and equipment.
49

50 **WIRING INSTALLATION IN RACEWAYS**

51 Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling conditions when
52 necessary.
53
54

55 Install wire in raceway after interior of building has been physically protected from the weather and all mechanical
56 work likely to injure conductors has been completed.
57
58

1 **FREE-AIR CABLE INSTALLATION**

2 Cabling shall be neatly run at right angles and be kept clear of other trades work.

3

4 Cabling shall be supported at a maximum of 4-foot intervals utilizing “J-Hook” or “Bridal Ring” supports anchored to
5 ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another
6 support shall be provided. Cable supports shall be installed to maintain cable bend to larger than the minimum bend
7 radius.

8

9 Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended
10 ceiling supports or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach
11 cable in any manner to the ceiling grid wires.

12

13 To reduce or eliminate Electro-Magnetic Interference (EMI), the following minimum separation distances for ‘Free-
14 Air’ cabling installations shall be adhered to:

15

- 16 • Twelve (12) inches from power lines of less than 5kV.
- 17 • Thirty-nine (39) inches from power lines of 5kV or greater.
- 18 • Five (5) inches from lighting fixtures.
- 19 • Thirty-nine (39) inches from transformers and motors.

20

21 A coil of 4 feet in each cable shall be placed in the ceiling at each ‘free-air’ wired device. These coils shall be secured
22 (wire tied) at the last cable support before the cable reaches the device and shall be coiled from 100% to 200% of the
23 cable recommended minimum bend radius.

24

25 All cable shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and
26 junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to
27 spread the strain over a longer length of cable.

28

29 Cable manufacturers minimum bend radius shall be observed in all instances. Care should be taken in the use of
30 cable ties to secure and anchor the station cabling. Ties should not be over tightened as to compress the cable jacket.
31 No sharp burrs should remain where excess length of the cable tie has been cut.

32

33 All exposed vertical cable extensions to devices located below the finished ceiling shall be in conduit.

34

35 Use suitable cable fittings and connectors.

36

37 **WIRING CONNECTIONS AND TERMINATIONS**

38 Splice only in accessible junction boxes (except splices to low voltage occupancy sensor power packs and terminations
39 to temperature control devices).

40

41 All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the
42 conductor.

43

44 Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.

45

46 Thoroughly clean wires before installing lugs and connectors.

47

48 At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

49

50 **FIELD QUALITY CONTROL**

51 Field inspection and testing will be performed under provisions of Section 26 05 04.

52

53

END OF SECTION

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**SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

SCOPE

The work under this section includes equipment grounding conductors, and bonding for Electrical and Communications systems. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Regulatory Requirements

PART 2 - PRODUCTS

- Mechanical Connectors
- Compression Connectors
- Conductors
- Bus/Busbar

PART 3 - EXECUTION

- General
- Less Than 600 Volt System Grounding
- Communication System Grounding
- Field Quality Control
- Identification and Labeling
- Construction Verification Items
- Warranty

All hardware, cables and related termination and support hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in this and related sections.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

REFERENCES

- ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems
- UL 467 Electrical Grounding and Bonding Equipment
- IEEE 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding
- TIA-607-C - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

REGULATORY REQUIREMENTS

Conform to requirements of NFPA 70.

Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 - PRODUCTS

MECHANICAL CONNECTORS

The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lock washers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.

Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.

1 The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and
2 manufacturer.

3

4 **COMPRESSION CONNECTORS**

5 The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall
6 be no less than 99% by IACS standards.

7

8 Each connector shall be factory filled with an oxide-inhibiting compound.

9

10 The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

11

12 The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required
13 compression tool settings.

14

15 The installation of the connectors shall be made with a compression tool and die system, as recommended by the
16 manufacturer of the connectors, and shall be irreversible.

17

18 Pre-crimping of the ground rod is required for all irreversible compression connections to a ground rod.

19

20 Terminal lug for communication system grounding shall be compression type and conform to the following:

21

Material: Tin Plated Copper (aluminum not permitted).

22

Wire Size: to match conductor

23

Number of Stud Holes: 2

24

Stud Hole Size: 3/8"

25

Bolt Hole Spacing: per TIA-607-C

26

Tongue Angle: Straight

27

28 **CONDUCTORS**

29 Material: Stranded copper (aluminum not permitted).

30

31 Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70,
32 whichever is larger. Differentiate between the normal ground and the isolated ground when both are used at the
33 same facility.

34

35 Branch Circuit Equipment Ground shall be proportionately increased in size when routed with phase conductors
36 increased in size.

37

38 Conductors for Telecommunications shall be as follows:

39

Telecommunications Bonding Conductor (TMGB to Service Ground): No. 3/0 minimum or as shown on
40 drawings.

41

Telecommunications Bonding Backbone (TBB; TMGB to TGB): No. 3/0 minimum or as shown on drawings.

42

Telecommunications Grounding Equalizer (GE): No. 3/0 minimum or as shown on drawings.

43

Bonding Conductors shall be insulated with a Green Jacket or jacket marked with Green Tape or labeled per
44 NEC Guidelines.

45

46 **BUS/BUSBAR**

47 Material: Copper (aluminum not permitted).

48

49 Size:

50

All Power systems: 1/4" X 2", length as needed (24" minimum).

51

Telecommunications Main Ground Busbar (TMGB): 1/4" x 4" x 20" long (minimum).

52

Telecommunications Grounding Busbar (TGB): 1/4" x 2" x 12" long (minimum).

53

54 Busbars:

55

Be pre-drilled to accommodate two-hole lugs.

56

3/8" stud hole size; hole spacing per TIA-607-C.

57

Incorporate insulators and stand-off brackets that electrically isolate busbar from mounting surface.

58

1 Provide main ground busbar located adjacent to main electrical service equipment to terminate all ground
2 conductors. Refer to DFD grounding detail 26 05 26-1.

3

4

5

PART 3 - EXECUTION

6

7

GENERAL

8

Install Products in accordance with manufacturer's instructions.

9

10

Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over
11 mechanical ground connections.

12

13

Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

14

15

Attach grounds permanently before permanent building service is energized.

16

17

Terminate each grounding conductor on its own terminal lug. Sharing a single lug by multiple conductors is not
18 allowed.

19

20

All grounding electrode conductors and individual grounding conductors shall be installed in PVC conduit, in exposed
21 locations.

22

23

LESS THAN 600 VOLT ELECTRICAL SYSTEM GROUNDING

24

Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway.
25 Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the
26 respective enclosure.

27

28

Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical
29 equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and
30 plumbing systems.

31

32

COMMUNICATION SYSTEM GROUNDING

33

Grounding and Bonding System for Communications shall be an isolated grounding system with a single ground point.
34 That ground point is to be the common grounding electrode system at the building electrical service entrance (main
35 ground bar located in electrical room).

36

37

The system shall be compliant with ANSI J-STD-607-B with the exception that the ground cable shall not be bonded to
38 building steel except at the electrical service entrance.

39

40

Provide Grounding Busbar for Telecommunications at each Telecommunications Room, the Main Equipment Room
41 and at the electrical service entrance per project drawings. Coordinate Busbar location(s) and conductor routing per
42 drawings with Division 27 contractor.

43

44

Provide Telecommunications Bonding Conductor from Telecommunications Main Grounding Busbar (TMGB) at the
45 Communications Entrance Facility to building common grounding electrode system. Attach grounding conductor to
46 building steel as allowed only at the main electrical service entrance. Provide physical protection as required.

47

48

Provide Telecommunications Bonding Backbone (TBB) conductor from the TMGB to Telecommunications Grounding
49 Busbar (TGB) at each Telecommunication Room, Telecommunications Equipment Room and Telecommunications
50 Enclosure.

51

TBB shall be continuous and not connected through Telecommunications Grounding Busbars (TGBs).

52

Bond TGBs to TBB via tap off of TBB. Gauge of conductor to be same as TBB.

53

Leave 10 feet slack in conductor from TBB to TGB at TGB location(s).

54

Do not bond TBB or TGB to building steel at TGB location(s).

55

56

FIELD QUALITY CONTROL

57

Inspect grounding and bonding system conductors and connections for tightness and proper installation.

58

1 Provide resistance test at each electrical and telecommunications Busbar to ground.

2

3 **IDENTIFICATION AND LABELING**

4 Label Grounds at point of termination.

5

6 **CONSTRUCTION VERIFICATION**

7 Record locations of all electrical and telecommunications grounding electrodes, busbars and grounding conductors as
8 installed including recorded ground resistance test results.

9

10 **WARRANTY**

11 See Division 1, General Conditions, and General Requirements.

12

13

END OF SECTION

- 1 ○ All strut, fittings and hardware shall be made of AISI Type 304 or Type 316 stainless steel as
2 indicated.

3
4 Conduit Supports

- 5 • Conduit clamps, straps, supports, etc., shall be steel or malleable iron.
6
7 • One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid
8 steel conduit is installed on the interior or exterior surface of any exterior building wall.
9
10 • Above suspended ceilings, bar joist conduit hangers: Spring Steel Clips with Snap-Close Clamps (Conduit
11 Supports): Conduit clamps shall pivot a full 360 degrees and shall snap close around the conduit. Push-in
12 type conduit clamps are not allowed. Spring clips shall require a hammer to install onto supporting surface.
13
14 • Stud wall applications: Spring Steel Clips with Push-in or Snap-Close Conduit Clamps (Conduit Supports):
15 Conduit clamps shall pivot a full 360 degrees. Spring clips shall require a fastener to install onto stud.
16
17 • Box/conduit hanger with rod/wire clip (a.k.a. antlers): One assembly provides support for electrical box and
18 conduit from drop wire or rod. Conduit clamps shall snap close around the conduit.
19
20 • Spring Steel Clip products shall be provided with corrosion resistance and be warranted against failure from
21 corrosion for a period of ten (10) years from date of manufacture.
22

23 Threaded Rod: Minimum sized threaded rod for supports shall be 3/8" for trapezes and single conduits 1-1/4" and
24 larger, and 1/4" for single conduits 1" and smaller.

25
26 Hardware: Corrosion resistant, or as noted for each product above.
27

28 **PART 3 - EXECUTION**

29
30 **INSTALLATION**

31 Fasten hanger rods, conduit clamps, and outlet-, junction-, and pull-boxes to building structure using pre-cast insert
32 system, preset inserts, beam clamps, or expansion anchors.
33

34 Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion
35 anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet
36 metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be
37 removable type anchors.
38

39 Powder-actuated fasteners are not permitted.
40

41 Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended
42 ceiling grid system.
43

44 Do not drill structural steel members unless approved by City of Madison.
45

46 Furnish and install all supports as required to fasten all electrical components required for the project, including free
47 standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.
48

49 Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat
50 appearance. Use hexagon head bolts with spring lock washers under all nuts.
51

52 Support Channel

53 Use one of the following types of support channel as appropriate for the installed environment:

- 54 • Indoor: Epoxy Painted Steel, Hot-dipped Galvanized Steel, or as noted on the drawings.
55
56 • Exterior and wet locations: Hot-dipped Galvanized Steel or Stainless Steel, as appropriate for the
57 environment or as noted on the drawings. Type 316 stainless steel shall be used for Food Service type
58 environments. Epoxy painted support channel shall not be used for exterior installations.

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- Field cuts: File and de-bur cut ends of support channel and paint to prevent rusting. For epoxy-painted support channel, paint cut ends to match the original color. For hot-dipped galvanized support channel, spray cut ends with cold galvanized paint.

Support Wires

- Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways, cables assemblies, boxes, cabinets, and fittings shall be secured at both ends (e.g. the ceiling structure at the top and the ceiling grid at the bottom) per NEC 300.11(A).
- Compressed-air power-actuated fasteners may ONLY be used for the installation of separate ceiling wires required for support of conduits and aircraft cable hung light fixtures.
- Support wires shall be identified per specification section 26 05 53.

Spring Steel Clip Conduit Supports

- Above suspended ceilings: Spring steel clips with snap-close clamps may be used to support conduit from bar joist (steel truss) systems above suspended ceilings.
- Stud wall applications: Spring steel clips with push-in or snap-close conduit clamps may be used to support conduit in interior metal stud wall applications. Use screw fasteners to install conduit clamp onto stud.
- Box/conduit hanger with rod/wire clip (a.k.a. antlers): These may only be used in limited applications with the pre-approval of the State of Wisconsin Electrical Inspector.

END OF SECTION

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**SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

SCOPE

This section describes the products and execution requirements relating to furnishing and installing raceways and boxes and related systems as part of a raceway system for electrical, communications, and other low-voltage systems for the project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Submittals

PART 2 - PRODUCTS

- General
 - Rigid Metal Conduit (RMC) and Fittings
 - PVC Coated Rigid Metal Conduit
 - Intermediate Metal Conduit (IMC) and Fittings
 - Electrical Metallic Tubing (EMT) and Fittings
 - Liquidtight Flexible Metal Conduit (LFMC) and Fittings
 - Conduit Supports
 - Surface Metal Raceway
 - Pull and Junction Boxes
 - Outlet Boxes
 - Boxes for Audio-Video Equipment
 - Boxes for Fire Alarm Audio-Visual Notification Appliances

PART 3 - EXECUTION

- Conduit Sizing, Arrangement, and Support
- Conduit Installation
- Conduit Installation Schedule
- PVC Coated Rigid Metal Conduit Installation
- Surface Metal Raceway and Multi-Outlet Assembly Installation
- Coordination of Box Locations
- Pull and Junction Box Installation
- Outlet Box Installation
- Audio-Video System Box and Conduit Installation

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

- Section 26 05 26 – Grounding and Bonding for Electrical Systems
- Section 26 05 29 – Hangers and Supports for Electrical Systems
- Section 26 27 02 – Equipment Wiring Systems
- Section 26 27 26 – Wiring Devices.

REFERENCES

ANSI/TIA-569-C-Telecommunications Pathways and Spaces

SUBMITTALS

Surface Raceway System - submit product data and catalog sheets for all components.

Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2 - PRODUCTS

GENERAL

All steel fittings and conduit bodies shall be galvanized.

No cast metal or split-gland type fittings permitted.

Mogul-type condulets larger than 2 inch (50 mm) not permitted except as approved or detailed.

All condulet covers must be fastened to the condulet body with screws and be of the same manufacture.

C-condulets shall not be used in lieu of pull boxes.

All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

RIGID METAL CONDUIT (RMC) AND FITTINGS

Conduit: Heavy wall threaded, galvanized steel, schedule 40.

Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

PVC COATED RIGID METAL CONDUIT

PVC Externally Coated Conduit: Rigid heavy wall, schedule 40, steel conduit with external 40 mil (0.1 mm) PVC coating. Conduit must be hot dipped galvanized inside and out including threads. The PVC coating bond to the galvanized steel conduit shall be stronger than the tensile strength of the coating itself.

Fittings and Conduit Bodies: Threaded type, material to match conduit. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the pipe outside steel diameter or two inches (50 mm) whichever is greater.

INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

Conduit: Galvanized steel, threaded.

Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

Conduit: Steel, galvanized tubing.

Fittings: All steel, set screw type. No push-on or indenter types permitted.

Conduit Bodies: All steel threaded conduit bodies.

LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) AND FITTINGS

Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.

Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

Conduit: Rigid non-metallic conduit, Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90° C conductors. Schedule 80 for locations exposed to physical damage or as required.

Fittings and Conduit Bodies: NEMA TC 2, Listed.

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CONDUIT SUPPORTS

See section 26 05 29.

SURFACE METAL RACEWAY

Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

Provide as directed on the plans.

PULL AND JUNCTION BOXES

Interior Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.

Interior Sheet Metal Boxes larger than 12 inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.

Boxes 9 square feet and larger shall have hinged covers. Single covers shall not exceed 10 square feet.

Interior Sheet Metal Boxes connected to an exterior underground raceway shall have a drain hole located in the bottom of the box.

Exterior Boxes and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain-tight. PVC box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

Box extensions and adjacent boxes within 48 inches of each other are not allowed for the purpose of creating more wire capacity.

Junction boxes 6 inch-by-6 inch or larger size shall be without stamped knock-outs.

Wireways shall not be used in lieu of junction boxes.

OUTLET BOXES

Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.

Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.

Concrete Ceiling Boxes: Concrete type.

Cast Boxes: Cast ferrous alloy or aluminum, deep type, gasketed cover, threaded hubs.

BOXES FOR AUDIO-VIDEO EQUIPMENT

Provide floor, wall, and/or ceiling boxes for Audio-Video (AV) Equipment as indicated on the Electrical and/or Audio-Video drawings.

FLAT SCREEN MONITOR BOXES

Provide a recessed wall box for mounting behind flat screen monitors, allowing the screens to sit flush against the wall. These boxes shall provide a neat and secure environment for the audio, video, control and power connections.

The recessed wall box shall install easily between any two standard studs in the wall. Connections and cable entry can be on the top or the bottom depending on installation preference.

The recessed wall box shall be provided with one low-voltage conduit entry box and Nationally Recognized Testing Laboratory (NRTL) listed single gang box for AC power.

The recessed wall box cover shall be provided in white or black and shall be suitable for painting. The cover shall have a cable exit slot for the display connections and the excess cable can easily be hidden inside of the box making the entire installation as clean as possible. The cover screws onto the front of the box once all connections are in place.

1 The recessed wall box shall be designed for new or existing construction. Brackets shall be included for mounting to
2 studs in new construction as well as surface mount clips for mounting to sheet rock or plywood in existing
3 construction.

4
5 **BOXES FOR FIRE ALARM AUDIO-VISUAL NOTIFICATION APPLIANCES**

6 Recessed boxes for Fire Alarm audio, visual, and audio-visual notification appliances shall be galvanized steel sheet
7 metal with stamped knockouts. Boxes shall be painted red.

8
9 For surface mounting, use manufacturer supplied back boxes and trim plates, painted red or off white to match
10 device color, and shall contain no visible conduit knock-outs. Mark each device with its circuit number.

11
12 **PART 3 - EXECUTION**

13
14 **CONDUIT SIZING, ARRANGEMENT, AND SUPPORT**

15 EMT is permitted to be used in sizes 4 inch (100 mm) and smaller for power and low-voltage systems. See CONDUIT
16 INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.

17
18 Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch (16 mm) minimum except
19 **all homerun conduits shall be 3/4 inch (21 mm)**, or as specified elsewhere. **Caution: Per the NEC, the allowable**
20 **conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway.**
21 **Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring**
22 **system.**

23
24 Size communications and other low-voltage systems raceways as follows:

25 Communications, including Outlet Box: 1 inch minimum. Conduit used for single device locations (e.g.
26 Wireless Access Point, Video Surveillance Camera, and Wall mounted telephone) may be 3/4 inch minimum.

27
28 Control, security, signal, video, and other low-voltage applications: 3/4 inch minimum.

29
30 Fire Alarm: 1/2 inch minimum.

31
32 Provide one raceway from each communications outlet box to above accessible ceiling.

33
34 Arrange conduit to maintain 6'-8" clear headroom and present a neat appearance.

35
36 Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

37
38 Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm) clearance
39 between conduit and heat sources such as flues, steam pipes, and heating appliances.

40
41 Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using
42 galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized
43 hangers.

44
45 Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel
46 channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

47
48 Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for
49 temporary conduit support during construction.

50 Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.

51
52 Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other
53 conduits, etc., unless so approved or detailed.

54
55 Conceal all conduits except where noted on the drawings or approved by the Architect/Engineer. Contractor shall
56 verify with Architect/Engineer all surface conduit installations except in mechanical rooms.

- 1 Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel
2 conduit bodies.
3
4 For indoor conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.
5
6 All conduits installed in exposed areas shall be installed with a box offset before entering box.
7
8 **CONDUIT INSTALLATION**
9 Cut conduit square; de-burr cut ends.
10
11 Conduit shall not be fastened to the corrugated metal roof deck.
12
13 Bring conduit to the shoulder of fittings and couplings and fasten securely.
14
15 Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to
16 sheet metal boxes in damp or wet locations.
17
18 Threads cut in the field, and factory threads of conduit and nipples not coated with corrosion protection, shall be
19 coated with an approved electrically conductive corrosion compound per NEC 300.6.
20 Corrosion inhibitor, when used in a food service environment, shall be approved for Food Service locations.
21
22 Terminate all conduit (except for terminations into conduit bodies) using conduit hubs, or connectors with one
23 locknut, or utilize double locknuts (one each side of box wall).
24
25 Provide bushings for the ends of all conduit not terminated in a box. Refer to Section 26 05 26 – Grounding and
26 Bonding for Electrical Systems for grounding bushing requirements.
27
28 Provide insulated bushings where raceways contain 4 AWG or larger conductors.
29
30 Communication and Low Voltage systems conduits shall terminate in horizontal plane.
31
32 Install no more than the equivalent of:
33 Three 90 degree bends between boxes for electrical systems.
34
35 Two 90 degree bends between boxes for communications and other low voltage systems. Note: Offsets
36 shall be considered 90 degrees.
37
38 No single bend may exceed 90 degrees.
39
40 Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless
41 sweep elbows are required.
42
43 Bend conduit according to manufacturer's recommendations. Torches or open flame shall not be used to aid in
44 bending of PVC conduit.
45
46 Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.
47
48 Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
49
50 Install listed expansion-deflection fitting or other approved means shall be used where a raceway crosses a structural
51 joint for expansion, contraction or deflection, used in buildings, bridges, parking garages or other structures.
52
53 Route conduit through roof openings for piping and ductwork where possible.
54
55 Where communication cabling is to be installed in conduit to the wiring hub (e.g. Telecom Room), multiple conduits
56 may be consolidated into fewer, larger conduits. Capacity of shared conduits shall equal the capacity of the individual
57 conduits unless otherwise noted.
58

1 Use NRTL listed metallic grounding clamps when terminating conduit to cable tray.

2
3 Ground and bond conduit under provisions of Section 26 05 26.

4
5 Conduit is not permitted in any slab topping of two inches (50 mm) or less.

6
7 PVC conduit in concrete pole bases shall transition to galvanized rigid metal conduit 12 inches before it enters a
8 concrete pole base. Inside the pole base, the elbow shall be galvanized rigid metal conduit. From the elbow, the
9 conduit shall transition back to PVC as it continues up and out the top of the concrete pole base.

10
11 PVC conduit shall transition to galvanized rigid metal conduit before it enters a foundation wall or up through a
12 concrete floor.

13
14 Identify conduit under provisions of Section 26 05 53.

15
16 Clean PVC conduit with solvent, and dry before application of glue. The temperature rating of glue/cement shall
17 match weather conditions. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The
18 entire installation shall meet manufacturer's recommendations.

19
20 **CONDUIT INSTALLATION SCHEDULE**

21 Conduit other than that specified below for specific applications shall not be used.

- 22
- 23 • Wet Interior Locations: Exposed: Rigid Metal conduit, Schedule 80 PVC conduit, PVC coated Rigid Metal
24 conduit.
 - 25
 - 26 • Concealed Dry Interior Locations: Rigid Metal conduit, Intermediate Metal conduit, Electrical Metallic
27 Tubing.
 - 28
 - 29 • Interior Building Grounding Electrode Conductor: Schedule 80 PVC.
 - 30
 - 31 • Exposed Dry Interior Locations: Rigid Metal conduit, Intermediate Metal conduit, Electrical Metallic
32 Tubing.
 - 33
 - 34 • Motor and equipment connections: Liquidtight flexible metal conduit (LFMC) (all locations). Minimum
35 length shall be one foot (300 mm); maximum length shall be three feet (900 mm). Conduit must be
36 installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
 - 37
 - 38 • Light fixtures: Refer to specification section 26 51 13.
 - 39

40 **PVC COATED RIGID METAL CONDUIT INSTALLATION**

41 Installers of PVC Coated Rigid Metal Conduit shall be factory trained and certified in the proper installation methods
42 for this type of conduit. Proof of such certification shall be kept on the project site at all times and shall be produced
43 upon request.

44
45 **SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY INSTALLATION**

46 Use flat-head screws to fasten channel to surfaces every twenty-four (24) inches. Mount plumb and level.

47
48 Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

49
50 Maintain grounding continuity between raceway components to provide a continuous grounding path under
51 provisions of Section 26 05 26.

52
53 Fastener Option: Use clips and straps suitable for the purpose.

54
55 **COORDINATION OF BOX LOCATIONS**

56 Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections,
57 and code compliance.

- 1 Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor
2 boxes and outlets in offices and work areas prior to rough-in.
3
- 4 No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers,
5 benches, counters, etc.
6
- 7 Conduit and boxes shall not be fastened to the metal roof deck. If conduit and boxes are required to be located and
8 installed on roof decks, the conduit and boxes are required to be spaced minimum 1-5/8 inch off the lowest part of
9 the metal roof decking material, per NEC 300.4 (E).
10
- 11 It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets
12 with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
13
- 14 In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the
15 Architect/Engineer and install outlet as instructed by the Architect/Engineer.
16
- 17 The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to
18 the Contractor for moving outlets which were improperly located.
19
- 20 Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide
21 18 inch (450 mm) by 24 inch (600 mm) access doors. Boxes must be installed within 12" from edge of the access door.
22
- 23 Locate and install to maintain headroom and to present a neat appearance.
24
- 25 Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and
26 methods.
27
- 28 **PULL AND JUNCTION BOX INSTALLATION**
- 29 Boxes shall be minimum 4 inches square (100 mm) by 2 1/8 inches (54 mm) deep for use with 1 inch (25 mm) conduit
30 and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit, minimum box size shall be 4 11/16 inches
31 square by 2 1/8 inches deep.
32
- 33 Where used with raceway(s) containing conductors of 4 AWG or larger, box shall be sized as required unless
34 otherwise noted on the drawings.
35
- 36 Where used with raceway(s) containing conductors on systems over 600V, size box per NEC 314 Part IV unless
37 otherwise noted as larger on the drawings.
38
- 39 Size boxes for communications per ANSI/TIA-568-C.
40
- 41 Locate boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-
42 accessible ceilings where boxes are installed. All boxes are to be readily-accessible.
43
- 44 Provide boxes for communications and other low voltage applications (a) in any section of conduit longer than 100
45 feet, (b) where there are bends totaling more than 180 degrees between pull points or pull boxes and (c) wherever
46 there is a reverse bend in run. Locate boxes on straight section of raceway (e.g. do not use boxes in place of raceway
47 bends).
48
- 49 Support boxes independent of conduit.
50
- 51 **OUTLET BOX INSTALLATION**
- 52 Do not install boxes back-to-back in walls. Provide minimum 6 inch (150 mm) separation, except provide minimum 24
53 inch (600 mm) separation in acoustic-rated walls.
54
- 55 Power:
- 56 Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction, or drywall shall be
57 minimum 4 inch square, with device rings. Device covers shall be square-cut except rounded corner plaster
58 rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry

1 cutting to achieve neat openings for boxes. A single gang box can be used in drywall and masonry, for a
2 single device location, when a single conduit enters box.

3
4 Shallow 4 inch square by 1 1/2 inch deep boxes can be used as device boxes for power provided the box and
5 plaster ring is sized for installed device and conductors.

6
7 **Low Voltage:**

8 Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction or drywall shall be
9 minimum 4 11/16 inch square by 2 1/8 inch deep with single gang device ring (unless noted otherwise on
10 drawings). Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall
11 applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat
12 openings for boxes.

13
14 Provide one conduit from each communications outlet box. Conduit runs between outlet boxes for
15 communications are not allowed. Terminate conduit above accessible ceiling in corridor.

16
17 Provide knockout closures for unused openings.

18
19 Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both
20 supported within 12 inches (300 mm) of box.

21
22 Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide
23 non-metallic barriers to separate wiring of different voltage systems.

24
25 Install boxes in walls without damaging wall insulation.

26
27 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

28
29 Ceiling outlets shall be 4 inch square, minimum 2 1/8 inch (54 mm) deep except that concrete boxes and plates will be
30 approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.

31
32 In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed luminaire, to be
33 accessible through luminaire ceiling opening.

34
35 Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately
36 positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall,
37 and adjustable steel channel fasteners for flush ceiling outlet boxes.

38
39 Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

40
41 Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.

42
43 Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements. For three
44 gang or larger requirements, use gang boxes with non-overlapping covers.

45
46 **AUDIO-VIDEO SYSTEM BOX AND CONDUIT INSTALLATION**

47 Conduit requirements for AV systems cabling may differ from those of other trades. It is important that the electrical
48 contractor become familiar with these specialized requirements. AV systems cabling must be enclosed within
49 continuously grounded ferrous metallic conduit or raceway. PVC conduit is not acceptable. Conduit and raceway is to
50 be furnished and installed by electrical contractor. Conduits containing different wiring classes must maintain
51 minimum separations to minimize interferences from electrical noise. Conduits sizes and quantities shown on bid
52 documents are minimums. Separate conduit runs specified in bid documents may not be combined for any purpose.

53
54 Conduit runs entering or exiting the audio equipment racks shall be electrically isolated from the racks. PVC or other
55 non-conductive fittings shall be used to isolate the conduit from the audio equipment racks.

56
57 Provide AV boxes as shown on the Electrical and/or Audio-Video drawings. Install boxes at heights and locations as
58 indicated on the drawings. Coordinate all box installations with the AV equipment provider.

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Flat screen monitor boxes shall be installed so that all cabling is concealed behind the monitor. Coordinate box location with flat screen mounting brackets so that the box cover and cables are not blocked by the brackets.

END OF SECTION

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1
2 **PART 3 - EXECUTION**

3
4 **GENERAL**

5 Where mixed voltages are used in one building (e.g. 4160 volt, 480 volt, 208 volt) each switch, switchboard, junction
6 and pull box, equipment, etc., on each system shall be labeled for voltage in addition to other requirements listed
7 herein.

8
9 All branch circuit and power panels shall be identified with the same symbol used in circuit directory in main
10 distribution center.

11
12 Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent. Install all
13 labels firmly as recommended by the label manufacturer. Labels shall be installed plumb and neatly on all equipment.

14
15 Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using screws, rivets or
16 manufacturer approved adhesive or cement.

17
18 Embossed tape shall not be permitted for any application.

19
20 Provide all warning labels to electrical equipment as required per NEC 110.16 and 110.21. Provide available fault
21 current labeling to service equipment as required per NEC 110.24.

22
23 Fire pump disconnecting means shall be marked as "Fire Pump Disconnecting Means", per NEC 695.4(B)(3)(c).

24
25 **BOX IDENTIFICATION**

26 The following junction and pull boxes shall be identified utilizing spray painted covers:

27

28 System	28 Color(s)
29 Secondary Power – 480Y/277V	Brown
30 Secondary Power – 208Y/120V, 240/120V	White
31 Fire Alarm (see below)	Red
32 Temperature Control	Green
33 Door Access Control	Orange
34 Communications	Blue

35
36 All boxes with power wiring shall be further identified with circuit numbers and source panel designation as follows:

- 37
- 38 • All outlet and device boxes shall use machine-generated adhesive labels, or neatly hand-written permanent
39 marker.
 - 40 • All exposed junction and pull boxes larger than 8" square shall utilize engraved nameplates with ½"
41 minimum letter height. All exposed junction and pull boxes 8" square or smaller shall utilize machine-
42 generated adhesive labels.
 - 43 • All junction and pull boxes located above an accessible ceiling shall utilize machine-generated adhesive
44 labels, or neatly hand-written permanent marker.
- 45
46

47 All fire alarm boxes (covers and outer sides) shall be painted red and labeled "Fire Alarm" or "FA". When red conduit
48 is used for the alarm system installation, there is no need to paint the box sides, - paint the covers only. Non-factory
49 device boxes shall also be painted red.

50
51 Other system boxes shall be further identified as shown on drawing details or approved shop drawings.

52
53 **COMMUNICATIONS CONDUIT LABELING**

54 Provide label on all conduits installed between Telecommunication Equipment Rooms. Both ends of the conduits
55 shall be labeled. All labels shall be mechanical, no hand-written labels.

56
57 The label shall indicate the location of the far end of the conduit run and a unique conduit number. (i.e. TR-1A-01 or
58 Room #216 – 01). Refer to agency standards where applicable.

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POWER, CONTROL AND SIGNALING WIRE IDENTIFICATION

Provide wire labels on each conductor in panelboard gutters, all boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control and signaling wires. All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated, including wiring used for temporary purposes.

WIRING DEVICE IDENTIFICATION

Wall switches, receptacles, occupancy sensors, photocells, poke-through fittings, access floor boxes, and time clocks shall be identified with circuit numbers and source (ex. Panel ABC-3). In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use machine-generated adhesive labels, or neatly hand-written permanent marker.

SUPPORT WIRE IDENTIFICATION

Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways, cables assemblies, boxes, cabinets, and fittings shall be distinguishable from the ceiling grid support wires per NEC 300.11(A). This identification shall be either approximately 6 inches of fluorescent orange paint, or orange tape flags 3/4 inches high-by-2 inches wide (minimum) within 12 inches of the bottom of the support wires.

NAMEPLATE ENGRAVING FOR ELECTRICAL EQUIPMENT

Provide nameplates of minimum letter height as scheduled below.

All Panelboards (Distribution, Branch, Sub-feed, and Feed-Through), Switchboards and Motor Control Centers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source. Panelboards serving NEC 700, 701 or 702 loads shall identify which branch they serve. Both panels in a double tub application shall be labeled.

Circuit Breakers, Switches, and Motor Starters in Distribution Panelboards, Switchboards and Motor Control Centers: 1/2 inch (13 mm); identify circuit number and load served, including location.

Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: 1/2 inch (13 mm); identify source and load served.

Transformers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify primary and secondary voltages, primary source and location, and secondary load and location.

PANELBOARD DIRECTORIES

Update existing directories with typed directories.

Typed directories for panelboards shall be covered with clear plastic, and have a metal frame. Room number on directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.

END OF SECTION

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SECTION 26 08 00
COMMISSIONING OF ELECTRIC POWER SYSTEMS

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PART 1 – GENERAL

1.1. SECTION INCLUDES

- A. Commissioning process requirements for electric power systems, assemblies, and components.

1.2. RELATED SPECIFICATIONS

- A. Section 01 31 13 Project Management and Coordination
- B. Section 01 91 13 General Commissioning Requirements

1.3. DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxP: Commissioning Provider.
- C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4. SUBMITTALS

- A. Certificates of readiness
- B. Certificates of completion, completed checklists, and test results for installation, prestart, and startup activities.

1.5. ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.6. CONTRACTOR’S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxP.
- B. Attend construction phase controls coordination meetings.
- C. Participate in electric power systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxP.
- D. Provide information requested by the CxP for final commissioning documentation.
- E. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- F. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- G. Provide written notification to the CM/GC and CxP that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

1 **1.7 COMMISSIONING PROVIDER'S RESPONSIBILITIES**

- 2 A. Provide Project-specific construction checklists and commissioning process test procedures for actual lighting
3 control systems, assemblies, equipment, and components to be furnished and installed as part of the
4 construction contract.
5 B. Direct commissioning testing.
6 C. Provide test data, inspection reports, and certificates in Systems Manual.
7

8 **1.8 COMMISSIONING DOCUMENTATION**

- 9 A. Provide the following information to the CxP for inclusion in the commissioning plan:
10 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
11 2. Identification of installed systems, assemblies, equipment, and components including design
12 changes that occurred during the construction phase.
13 3. Process and schedule for completing construction checklists and manufacturer's prestart and
14 startup checklists for systems, assemblies, equipment, and components to be verified and tested.
15 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have
16 been completed.
17 5. Certificate of readiness certifying that systems, subsystems, equipment, and associated controls
18 are ready for testing.
19 6. Test and inspection reports and certificates.
20 7. Corrective action documents.
21

22 **PART 2 – PRODUCTS**

23
24 **2.1 TEST EQUIPMENT**

- 25 A. Infrared thermographic scanner
26 1. Infrared scanning equipment shall be an AGA (or approved equal) thermos vision set capable of
27 viewing an entire bus or equipment assembly at one time and have a sensitivity of 0.2 degrees C
28 with a liquid nitrogen reference.
29 2. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system
30 performance with the tolerances specified.
31

32 **PART 3 – EXECUTION**

33
34 **3.1 TESTING PREPARATION**

- 35 A. Certify in writing to the CxP that electrical systems, subsystems, and equipment have been installed, calibrated,
36 and started and are operating according to the Contract Documents.
37 B. Certify in writing to the CxP that electrical power instrumentation and control systems have been completed and
38 calibrated, that they are operating according to the Contract Documents, and that pretest set points have been
39 recorded.
40 C. Certify in writing that testing procedures have been completed and that testing reports have been submitted,
41 discrepancies corrected, and corrective work approved.
42 D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal
43 auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
44 E. Inspect and verify the position of each device and interlock identified on checklists.
45 F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the
46 CxP.
47 G. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of
48 operation.
49

50 **3.2 GENERAL TESTING REQUIREMENTS**

- 51 A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxP.
52 B. Scope of electrical power system testing shall include the on-site renewable electricity generation systems and
53 emergency backup power systems.
54 C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions.
55 D. The CxP along with the Electrical contractor and other contracted subcontractors shall prepare detailed testing
56 plans, procedures, and checklists for on-site renewable electricity generation systems and emergency backup
57 power systems.
58 E. Tests will be performed using design conditions whenever possible.

- 1 F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design
- 2 conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads.
- 3 Set simulated conditions as directed by the CxP and document simulated conditions and methods of simulation.
- 4 After tests, return settings to normal operating conditions.
- 5 G. The CxP may direct that set points be altered when simulating conditions is not practical.
- 6 H. The CxP may direct that sensor values be altered with a signal generator when design or simulating conditions
- 7 and altering set points are not practical.
- 8 I. If tests cannot be completed because of a deficiency outside the scope of the electrical power systems,
- 9 document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- 10 J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and
- 11 documentation and schedule seasonal tests.
- 12

13 **3.3 ELECTRICAL POWER SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- 14 A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 26
- 15 sections. Provide submittals, test data, inspector record, and certifications to the CxP.
- 16 B. Electrical Instrumentation and Control System Testing: Assist the CxP with preparation of testing plans.
- 17

18 **3.4 ELECTRICAL TESTING AGENCY**

- 19 A. When requested by Owner, the Contractor shall retain an independent Electrical Testing Agency (ETA). This
- 20 generally requires checking and testing of the electrical power distribution equipment per National Electrical
- 21 Testing Association (NETA) or Authority having Jurisdiction.
- 22 B. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the
- 23 Contractor to facilitate the Commissioning process.
- 24 C. Obtain all required manufacturer's data to facilitate tests.
- 25 D. Provide assistance to the General or Electric Sub contractor in preparation of the specific Prefunctional Checklist
- 26 and Functional Performance. Generally, ETA shall provide their standard forms to document the NETA tests to be
- 27 incorporated into the Prefunctional Checklist and Functional Performance Tests record.
- 28 E. During related tests, execute and document the tests in the approved forms and/or test record.
- 29 F. Perform and clearly document all completed Start-up and system operational checkout procedures, providing a
- 30 copy to the Contractor.
- 31 G. Clearly indicate any deficiencies identified during testing and add to an action list for resolution and tracking.
- 32 The field technicians shall keep a running log of events and issues. Submit hand-written reports of discrepancies,
- 33 deficient or uncompleted work by others, Contract interpretation requests and lists of completed tests to the
- 34 Contractor at least twice a week and provide technical assistance in the resolution of deficiencies.
- 35 H. Provide skilled technicians to execute testing. Ensure that they are available and present during the agreed-
- 36 upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
- 37 I. Warranty Phase: Perform thermographic imaging of loaded panel at time designated by Electrical Subcontractor
- 38 or Contractor.
- 39
- 40

END OF SECTION

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SECTION 26 09 00
COMMISSIONING OF ELECTRIC LIGHTING

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PART 1 – GENERAL 1

1.1. SECTION INCLUDES 1

1.2. RELATED SPECIFICATIONS 1

1.3. DEFINITIONS 1

1.4. SUBMITTALS 1

1.5. ALLOWANCES 1

1.6. CONTRACTOR’S RESPONSIBILITIES 1

1.7. COMMISSIONING PROVIDER’S RESPONSIBILITIES 2

1.8. COMMISSIONING DOCUMENTATION 2

PART 2 – PRODUCTS [NOT USED] 2

PART 3 – EXECUTION 2

3.1. TESTING PREPARATION 2

3.2. GENERAL TESTING REQUIREMENTS 2

3.3. ELECTRICAL LIGHTING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES 3

PART 1 – GENERAL

1.1. SECTION INCLUDES

- A. Commissioning process requirements for electric lighting systems, assemblies, and components.

1.2. RELATED SPECIFICATIONS

- A. Section 01 31 13 Project Management and Coordination
- B. Section 01 91 13 General Commissioning Requirements

1.3. DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxP: Commissioning Provider.
- C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4. SUBMITTALS

- A. Certificates of readiness
- B. Certificates of completion, completed checklists, and test results for installation, prestart, and startup activities.

1.5. ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.6. CONTRACTOR’S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxP.
- B. Attend construction phase controls coordination meetings.
- C. Participate in electric power systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxP.
- D. Provide information requested by the CxP for final commissioning documentation.
- E. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- F. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- G. Provide written notification to the CM/GC and CxP that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

1 **1.7 COMMISSIONING PROVIDER'S RESPONSIBILITIES**

- 2 A. Provide Project-specific construction checklists and commissioning process test procedures for actual lighting
3 control systems, assemblies, equipment, and components to be furnished and installed as part of the
4 construction contract.
5 B. Direct commissioning testing.
6

7 **1.8 COMMISSIONING DOCUMENTATION**

- 8 A. Provide the following information to the CxP for inclusion in the commissioning plan:
9 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
10 2. Identification of installed systems, assemblies, equipment, and components including design
11 changes that occurred during the construction phase.
12 3. Process and schedule for completing construction checklists and manufacturer's prestart and
13 startup checklists for systems, assemblies, equipment, and components to be verified and tested.
14 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have
15 been completed.
16 5. Certificate of readiness certifying that systems, subsystems, equipment, and associated controls
17 are ready for testing.
18 6. Test and inspection reports and certificates.
19 7. Corrective action documents.
20

21 **PART 2 – PRODUCTS [NOT USED]**

22
23 **PART 3 – EXECUTION**

24
25 **3.1 TESTING PREPARATION**

- 26 A. Certify in writing to the CxP that electrical lighting systems, subsystems, and equipment have been installed,
27 calibrated, and started and are operating according to the Contract Documents.
28 B. Certify in writing to the CxP that electrical lighting instrumentation and control systems have been completed
29 and calibrated, that they are operating according to the Contract Documents, and that pretest set points have
30 been recorded.
31 C. Certify in writing that testing procedures have been completed and that testing reports have been submitted,
32 discrepancies corrected, and corrective work approved.
33 D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal
34 auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
35 E. Inspect and verify the position of each device and interlock identified on checklists.
36 F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the
37 CxP.
38

39 **3.2 GENERAL TESTING REQUIREMENTS**

- 40 A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxP.
41 B. Scope of electrical lighting system testing shall include the entire lighting installation.
42 C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions.
43 D. The CxP along with the Electrical contractor and other contracted subcontractors shall prepare detailed testing
44 plans, procedures, and checklists for electric lighting and lighting control systems.
45 E. Tests will be performed using design conditions whenever possible.
46 F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design
47 conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads.
48 Set simulated conditions as directed by the CxP and document simulated conditions and methods of simulation.
49 After tests, return settings to normal operating conditions.
50 G. The CxP may direct that set points be altered when simulating conditions is not practical.
51 H. The CxP may direct that sensor values be altered with a signal generator when design or simulating conditions
52 and altering set points are not practical.
53 I. If tests cannot be completed because of a deficiency outside the scope of the electric lighting and lighting
54 controls document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
55 J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and
56 documentation and schedule seasonal tests.
57

- 1 **3.3 ELECTRICAL LIGHTING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**
2 A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 26
3 sections. Provide submittals, test data, inspector record, and certifications to the CxP.
4 B. Electrical Instrumentation and Control System Testing: Assist the CxP with preparation of testing plans.
5
6

END OF SECTION

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**SECTION 26 24 16
PANELBOARDS**

PART 1 - GENERAL

SCOPE

The work under this section includes branch circuit panelboards. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Submittals
- Operation and Maintenance Data
- Spare Parts

PART 2 - PRODUCTS

- Branch Circuit Panelboards
- Coordination of Overcurrent Protective Devices

PART 3 - EXECUTION

- Installation
- Field Quality Control

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

REFERENCES

- ANSI C57.13 – Instrument Transformers
- NEMA AB 1 - Molded Case Circuit Breakers
- NEMA KS 1 - Enclosed Switches
- UL-891 - Dead Front Switchboards

SUBMITTALS

Include outline and support point dimensions, voltage, main bus ampacity, circuit breaker arrangement and sizes, and interrupting ratings confirming a fully-rated system for all equipment and components.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

SPARE PARTS

Keys: Furnish 2 keys for each panelboard to Owner.

Handle lock-off: Furnish (2) 20/1P circuit breaker handle lock-off devices for each panelboard to Owner.

One set of three spare fuses of each size and type utilized.

PART 2 - PRODUCTS

BRANCH CIRCUIT PANELBOARDS

Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.

The panelboard and overcurrent devices contained within shall be fully-rated.

Enclosure: Type 1. Minimum cabinet size: 5-3/4 inches (144 mm) deep; 20 inches (508 mm) wide with 5" minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.

Provide flush or surface cabinet front with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.

1 Provide metal directory holders with clear plastic covers. Holder to be factory mounted.

2
3 Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings.
4 Provide ground bars in all panelboards. Phase, neutral and ground bar terminations can be dual rated ALCU9. All spaces
5 shall have bus fully extended and drilled for the future installation of breakers.

6
7 Incoming conductors shall terminate at lug landing pads rated for the panelboard.

8
9 Provide compression type lugs to accommodate the conductor shown on drawings.

10
11 Minimum System (i.e. individual component) Short Circuit Rating: As required by short circuit/ coordination study.

12
13 Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers. Provide UL Class A ground fault
14 interrupter circuit breakers where shown on Drawings. Provide circuit breakers UL listed as Type HACR for air
15 conditioning equipment branch circuits.

16
17 Do not use tandem circuit breakers.

18
19 Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.

20
21 Provide a minimum of 10% spare circuit breakers in branch panelboards.

22
23 All of the panelboards provided under this section shall be by the same manufacturer.

24
25 All panelboards installed side by side (double tub) shall utilize same enclosure height.

26
27 Double tub panelboard installations shall identify type of feed to adjacent panelboard- sub-feed or feed-thru.
28 Identification shall be integral with panel label.

29
30 **COORDINATION OF OVERCURRENT PROTECTIVE DEVICES**

31 Provide a coordination study of the electrical system and recommend set points for all of the overcurrent and ground
32 fault trip adjustments on the equipment provided. The coordination study and set point recommendations shall be
33 submitted to the consulting engineer for approval. Submittal shall be on or before date of switchboard and panelboard
34 equipment submittal.

35
36 **PART 3 - EXECUTION**

37
38 **INSTALLATION**

39 See section 26 05 29 for support requirements.

40
41 Install panelboards plumb with wall finishes.

42
43 Height: Branch panelboards: 6'-0" to top of panelboard.

44
45 Install a crimp type stud termination to stranded conductor when terminating on circuit breakers without a captive
46 assembly rated for terminating stranded conductors.

47
48 Provide filler plates for unused spaces in panelboards.

49
50 See section 26 05 53 for identification requirements. Provide typed circuit directory for each panelboard per NEC
51 408.4(A). Revise directory to reflect circuiting changes required to balance phase loads.

52
53 Stub three (3) empty ¾" conduits to accessible location above ceiling or below floor out of each recessed panelboard.
54 Cap these conduits to prevent material from entering them.

55
56 **FIELD QUALITY CONTROL**

57 The Contractor shall circuit the panelboards as shown on the drawings. Measure steady state load currents at each
58 panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent, rearrange circuits in
59 the panelboard to balance the phase loads within 10 percent.

60
61 Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check
62 proper installation and tightness of connections.

63
64 **END OF SECTION**

1 **OTHER PRODUCTS**

2 Refer to related sections for other product requirements.

3

4

PART 3 - EXECUTION

5

6 **INSPECTION**

7 Verify that equipment is ready for electrical connection, wiring, and energizing.

8

9 **PREPARATION**

10 Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of
11 connections. Coordinate details of equipment connections with supplier and installer.

12

13 **INSTALLATION**

14 Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

15

16 Provide a green equipment ground conductor for all installed equipment wiring.

17

18 Make conduit connections to equipment using flexible PVC-coated metal conduit.

19

20 Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug
21 with suitable strain-relief clamps.

22

23 Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

24

25 Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with
26 manufacturer's instructions. Provide interconnecting wiring where indicated.

27

28 Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature
29 switches as indicated. Connect with conduit and wiring as indicated.

30

31 **MISCELLANEOUS CONNECTIONS**

32 Hand Dryers: Provide handle lock on source circuit breaker to serve as required lock open disconnect.

33

34 Drinking Fountains and Bottle Fill Fountains: Provide GFCI source circuit breaker to serve receptacle at fountain.

35

36 **HVAC AND PLUMBING CONNECTIONS**

37 Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through
38 starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control panels. Packaged control
39 panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control
40 panels and motors.

41

42 Contractor shall verify with mechanical contractor the electrical requirements including voltages, horsepower,
43 disconnecting means, starters and variable frequency drives for motors and equipment prior to ordering circuit
44 breakers, disconnects and starters.

45

46 Provide 120 volts to each temperature control panel. Coordinate quantity and exact locations with HVAC/DDC
47 contractors.

48

49 Unless otherwise specified, all electrical control devices such as aqua-stats, float and pressure switches, fan powered
50 VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper motors requiring mechanical
51 connections shall be furnished and installed and wired by the Contractor supplying the devices.

52

53 Provide 120V, single phase 15 ampere circuit and switching means to serve factory installed interior lighting within
54 each HVAC unit.

55

56 Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated metal
57 conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow
58 conduit to freely flex.

1
2 Check for proper rotation of each motor.

3

4 **EQUIPMENT CONNECTION SCHEDULE**

5 As indicated on the drawings.

6

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END OF SECTION

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**SECTION 26 27 26
WIRING DEVICES**

PART 1 - GENERAL

SCOPE

This section describes the products and execution requirements relating to furnishing and installing wiring devices and related systems for the project. Included are the following topics:

- PART 1 - GENERAL
 - Scope
 - Related Work
 - Submittals
 - Operation and Maintenance Data

- PART 2 - PRODUCTS
 - Modularly Connected (Modular) Devices
 - Wall Switches
 - Receptacles
 - Occupancy Sensors
 - Emergency Lighting Control Units
 - Wall Dimmers
 - Device Plates and Box Covers

- PART 3 - EXECUTION
 - Installation
 - Field Quality Control
 - Occupancy Sensors
 - Adjusting

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

SUBMITTALS

Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.

For occupancy sensor shop drawings, the manufacturer's actual layout of occupancy sensors and the wiring diagrams shall be provided.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

MODULARLY CONNECTED (MODULAR) DEVICES:

Modularly connected devices are allowed, but not required.

Modular Pigtailed Connector: Polarized connector with minimum six-inch stranded copper wire leads, polycarbonate right-angle housing, UL498 listed, with finger-safe connector housing which provides insulation from conductive surfaces. Contacts shall be brass. Connector shall be manufactured so that it provides a secure connection such that it will maintain contact with the device until the device is removed for replacement. Modular connectors shall be provided with covers which protect the contacts from paint, drywall mud, and construction dust and debris. Connectors shall be Hubbell SNAPConnect, Leviton Lev-Lok, Pass & Seymour PlugTail, or approved equal.

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WALL SWITCHES

General: Heavy duty use toggle switch, rated 20 amperes and 120 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade.

Handle: Ivory made of nylon or high impact resistant material.

All switches on emergency circuits shall have a red handle with matching red cover plate.

Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with separate green ground screw. Switches shall be as follows:

- Hubbell 1221*,
- Leviton 1221-S*,
- Pass & Seymour CSB20AC1-*,
- or approved equal. (* indicates color selection).

Modular Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: Switches shall be as follows:

- Hubbell SNAP1221*NA,
- Leviton M1221-*,
- Pass & Seymour PT20AC1-*,
- or approved equal. (* indicates color selection).

RECEPTACLES

General Requirements: NEMA Type 5-20R, ivory nylon or high impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated.

Generally, all receptacles shall be duplex convenience type unless otherwise noted.

All receptacles on emergency circuits shall have a red face with matching red cover plate.

All receptacles installed in bathrooms, kitchens, and within 6 feet of the outside edge of sinks shall be GFCI type.

All receptacles installed in outdoor locations, garages, rooftops, and in other damp or wet locations shall be GFCI type with a weather-resistant (WR) rating.

Convenience and Straight-blade Receptacles: All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be as follows:

- Hubbell 5362*,
- Leviton 5362-*,
- Pass & Seymour PS5362*,
- or approved equal. (* indicates color selection).

GFCI Receptacles: Duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A, including self-test functionality and reverse line-load misfire function repeatability. GFCI receptacles shall be as follows:

- Hubbell GFR5362SG*,
- Leviton GFNT2-*,
- Pass & Seymour 2097*,
- or approved equal. (* indicates color selection).

GFCI Receptacles with a weather-resistant (WR) rating: Weather-Resistant duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class-A, including self-test functionality and reverse line-load misfire function repeatability. WR GFCI receptacles shall be as follows:

- Hubbell GFR5362SG*,
- Leviton GFWR2-*,
- Pass & Seymour 2097TRWR*,

1 or approved equal. (* indicates color selection).
2

3 **USB Charger Receptacles:** Do not use combination duplex receptacles with USB chargers. Use duplex receptacles as
4 required for the application and as specified herein. Use separate 4-port USB charging devices.
5

6 **USB Charging Devices:** Single-gang 4-port USB charging station. USB ports shall meet UL94 for 5V flammability rating,
7 and shall comply with battery charging specification USB BC1.2. USB ports shall be compatible with USB 1.1/2.0/3.0
8 devices, including Apple products. USB ports shall be rated 5VDC, 4.2A minimum. Devices shall be as follows:

9 Hubbell USB4*,
10 Leviton USB4P-*,
11 Pass & Seymour TM8USB4*CC6,
12 or approved equal. (* indicates color selection).
13

14 **Locking-Blade Receptacles:** As indicated on drawings.
15

16 **Specific-use Receptacle Configuration:** As indicated on drawings.
17

18 **Modular Convenience and Straight-blade Receptacles:** Receptacles shall be as follows:

19 Hubbell SNAP5362*A,
20 Leviton M5362-*,
21 Pass & Seymour PT5362*,
22 or approved equal. (* indicates color selection).
23

24 **Modular GFCI Receptacles:** Duplex convenience receptacle with integral ground fault current interrupter meeting the
25 requirements of UL standard 943 Class A, including self-test functionality and reverse line-load misfire function
26 repeatability. GFCI receptacles shall be as follows:

27 Hubbell GFRST83SNAP*,
28 Leviton MGFN2-*,
29 Pass & Seymour PT2097*,
30 or approved equal. (* indicates color selection).
31

32 **Modular GFCI Receptacles with a weather-resistant (WR) rating:** Use back and side wired devices in lieu of modular
33 weather-resistant rated GFCI receptacles.
34

35 **OCCUPANCY SENSORS**

36 **General Requirements:** All occupancy sensors shall be hardwired type; battery type shall not be permitted.
37

38 Sensors shall use either passive infrared, or if dual technology, passive infrared and passive acoustic sensing or
39 passive infrared and ultrasonic sensing for detecting room occupancy.
40

41 Sensitivity shall be user adjustable or self-adjusting type.
42

43 The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The sensor shall
44 have a test mode for performance testing.
45

46 The test LED shall indicate motion.
47

48 Line voltage sensors are acceptable, especially in exposed ceiling areas where all wiring shall be installed in conduit,
49 including low voltage cabling if power packs are used. Provide power pack as required for low voltage sensors.
50

51 See drawings for actual types of sensors.
52

53 Occupancy sensors and power packs shall have five year warranties.
54

55 **Wall Mounted (Wall Switch Type):** The unit shall fit in/on a standard single gang switch box.
56

57 Rated capacity: 600 watts minimum at 120 volts, 60 Hz.

1 The sensor shall have two switches where dual-level lighting is required. The switch shall have manual override for
2 positive OFF and automatic ON.

3 The area of coverage shall be approximately 180 degrees by 35-40 feet.
4

5 **Ceiling Mounted:** The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be installed to a
6 box with ring and box support.
7

8 The coverage area shall be 360 degrees by approximately 15 feet radius when mounted at 9 foot height. The sensor
9 shall have provisions, such as masking, to block out problem areas.
10

11 **Ceiling/Corner Mounted:** The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be installed
12 to a box with ring and box support.
13

14 The coverage area shall be 90 degrees or greater by approximately 40 feet radius when mounted at 9 foot height. The
15 sensor shall have provisions, such as masking, to block out problem areas.
16

17 **Power Packs:** Provide power packs as required for low voltage sensors. Rated capacity shall be 20 amps at 120 volts.
18

19 The unit shall fit on a standard octagon box. All power packs shall be installed onto a supported box.
20

21 Low voltage cabling shall be plenum rated or installed in conduit in plenum-rated areas.
22

23 **Auxiliary Contacts for HVAC Interlock:** Provide auxiliary dry contacts for HVAC BAS interlock when required. Refer to
24 the "Occ Sensor Interlock" column in the Air Terminal Schedule(s) on the HVAC drawings. When required, provide
25 auxiliary contacts regardless if the occupancy sensors are line or low voltage.
26

27 The occupancy sensors and auxiliary contacts shall be wired such that the sensor still detects occupancy and controls
28 the auxiliary contacts regardless if the light switch(es) are in the OFF position (e.g. the occupant has turned the lights
29 OFF because there is enough daylight, but the occupant is still occupying the space, and the occupancy sensor senses
30 the occupant and closes the auxiliary contacts for BAS input).
31

32 The BAS wiring to the auxiliary contacts shall be by the Division 23 contractor.
33

34 **EMERGENCY LIGHTING CONTROL UNITS**

35 **General Requirements:** The Emergency Lighting Control Unit (ELCU) shall automatically illuminate connected
36 emergency lighting upon utility power interruption, regardless of room switch position or occupancy sensor state.
37

38 The ELCU shall be UL 924 listed.
39

40 Warranty shall be 5 year replacement warranty.
41

42 Local room switch or lighting control shall turn both normal and emergency luminaires ON at the same time (no
43 dedicated emergency room switch required).
44

45 The ELCU shall have a minimum load rating of 20 Amps at 120V, 1800W Tungsten at 120V,
46 1 HP, or general use 20 Amp circuits.
47

48 The ELCU shall accept 120V, 60Hz Input & Output (voltage tolerance +/- 15%).
49

50 The ELCU shall include emergency power and normal power indicator LEDs, and a manual test switch.
51

52 The ELCU shall accept separate phases on the constant hot and switched hot inputs.
53

54 The ELCU shall include high voltage input surge protection up to 50,000V.
55

56 Load contacts shall be able to withstand 10 direct shorts while connected to a 20 Amp breaker without permanent
57 damage.
58

- 1 The ELCU shall not generate any objectionable electrical or mechanical noise.
2
3 The ELCU shall have UL 94-VO or UL 94-5VA flame rating and be approved for installation above the suspended
4 ceiling.
5
6 **Dimming Applications:** The ELCU shall automatically illuminate connected emergency lighting to full brightness upon
7 utility power interruption, regardless of dimmer or switch position or occupancy sensor state.
8
9 The ELCU shall be compatible with 2-wire, 3-wire, 0-10V, and DALI dimming systems and ballasts.
10
11 The same local room switch, dimmer, or lighting control shall dim both normal and emergency luminaires at the same
12 level during normal operation.
13

14 **WALL DIMMERS**

15 General:

- 16 1. Compatible with the voltage of the circuit being controlled: 120V;
17 2. Compatible with the load being dimmed;
18 3. Linear full-range slide control;
19 4. Separate ON/OFF switch: single-pole, 3-way, or multiple-location operation as indicated on the drawings;
20 5. No derating required in multi-gang applications;
21 6. Polycarbonate construction;
22 7. Color to match receptacles and/or standard toggle switches.
23

24 Line-voltage LED Dimmer:

- 25 1. Forward or reverse phase dimming control as required for the application;
26

27 0-10 V Dimmers:

- 28 1. Ratings: 30 mA sink current;
29 2. Adjustable dial allows users to trim the low-end dimming range;
30

31 **DEVICE PLATES AND BOX COVERS**

32 **Decorative Cover Plate:** Stainless steel. Note requirement for red plates on emergency outlets and switches.
33

34 **Weatherproof Cover:** All receptacles installed in wet locations shall have an enclosure that is weatherproof whether
35 or not the attachment plug is inserted. Covers shall be gasketed metal with hinged "in-use" device covers, powder
36 coat painted. Non-metallic covers are not allowed. Covers shall be latching type and shall be lockable. Covers shall be
37 identified as "extra-duty" type per NEC 406.9(B)(1).
38

39 **Damp Location Cover:** All receptacles installed outdoors in a location protected from the weather or in other damp
40 locations shall have an enclosure that is weatherproof when the receptacle is covered (attachment plug not inserted
41 and receptacle covers closed). Covers shall be gasketed metal with hinged device covers, powder coat painted. Non-
42 metallic covers are not allowed.
43

44 **Surface Cover Plate:** Raised galvanized steel.
45

46 **PART 3 - EXECUTION**

47 **INSTALLATION**

48 See plans for device mounting heights.
49

50
51 Install wall switches with OFF position down.
52

53 Wall dimmers: de-rate ganged dimmers as instructed by manufacturer; do not use common neutral.
54

55 Install convenience receptacles with grounding pole on bottom.
56

57 Install box for information outlet at the same height as adjacent convenience receptacles. Locate boxes for
58 information outlet as close as practical to duplex power outlet, approximately 2-inches apart.

- 1
2 Install box for telephone jack for wall telephone at 46-inches to center above finished floor.
3
4 Install specific-use receptacles at heights shown on Contract Drawings.
5 Install decorative plates on switch, receptacle, and blank outlets in finished areas.
6
7 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on
8 surface-mounted outlets.
9
10 Install devices and wall plates flush and level.
11
12 Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding
13 receptacles using mounting screws as bonding means are not approved.

14
15 **FIELD QUALITY CONTROL**

- 16 Inspect each wiring device for defects.
17
18 Operate each wall switch and sensor with circuit energized, and verify proper operation.
19
20 Verify operation of each ELCU by turning off the normal power circuit breaker at the panelboard.
21
22 Verify that each receptacle device is energized.
23
24 Test each receptacle device for proper polarity.
25
26 Test each GFCI receptacle device for proper operation.
27
28 The City of Madison personnel reserve the right to be present at all tests.

29
30 **OCCUPANCY SENSORS**

- 31 Power packs used in return air plenum ceiling areas shall be installed in an approved enclosure or UL listed for return
32 air plenum.
33
34 Provide a minimum of 4' of coiled cable for ceiling-mounted sensors.
35
36 Occupancy sensors shall be installed at locations indicated on the manufacturer's submittal layout drawings. Sensors
37 shall be located to prevent false "ON" tripping of the lights.
38
39 Sensitivity Test: After the sensor has been energized for at least 15 minutes, walk to the middle of the room (if
40 conference room) or sit at the normal desk position (if an office). Make no motion for 20 seconds. Move one arm up
41 and down slowly. The test LED should blink.
42
43 Time Delay Test: Set the time delay for 10 minutes. Walk into the room to activate the sensor then leave room.
44 Sensor must turn lights off at approximately 10 minutes. Walk into the room again to reactivate the lights. Lights
45 should activate within 1 second.
46
47 For lights on emergency power *without* an emergency lighting control unit (ELCU), use the *emergency* circuit to
48 energize the occupancy sensor's power pack. Route the emergency circuit through the occupancy sensor's power
49 pack relay to the light fixtures. Route any non-emergency circuits controlled by the same occupancy sensor through
50 separate auxiliary relay packs.
51
52 For lights on emergency power *with* an ELCU, route the *normal* power through the switches and occupancy sensor
53 relay to the ELCU, then to the normal power lighting fixtures. Connect the emergency circuit to the ELCU's emergency
54 power terminals, then to the emergency lighting fixtures. The ELCU will control the emergency lighting along with the
55 normal lighting controls, but will turn the emergency lights ON in a power outage, regardless of the position of the
56 switches or relays.

57
58 **ADJUSTING**

- 1 Adjust devices and wall plates to be flush and level.
- 2
- 3 Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the
- 4 device, and on the back of the device cover.
- 5
- 6

END OF SECTION

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1
2 **SECTION 26 27 28**
3 **DISCONNECT SWITCHES**

4
5 **PART 1 - GENERAL**
6

7 **SCOPE**

8 The work under this section includes disconnect switches, fuses, and enclosures. Included are the following topics:
9

10 **PART 1 - GENERAL**

- 11 Scope
- 12 Related Work
- 13 References
- 14 Submittals
- 15 Operation and Maintenance Data
- 16 General

17
18 **PART 2 - PRODUCTS**

- 19 Disconnect Switches
- 20 Fuses

21
22 **PART 3 - EXECUTION**

- 23 Installation

24
25 **RELATED WORK**

26 Applicable provisions of Division 1 govern work under this Section.

27
28 Section 26 27 02 - Equipment Wiring Systems
29

30 **REFERENCES**

- 31 NECA (National Electrical Contractors Association) "Standard of Installation"
- 32 NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies
- 33 NEMA KS 1 – Enclosed Switches
- 34 UL 50 – Enclosures for Electrical Equipment
- 35 UL 98 – Enclosed and Dead-front Switches

36
37 **SUBMITTALS**

38 Include outline drawings with dimensions, and equipment ratings for voltage, ampacity, horsepower, and short
39 circuit.
40

41 **OPERATION AND MAINTENANCE DATA**

42 All operations and maintenance data shall comply with the submission and content requirements specified under
43 section GENERAL REQUIREMENTS.
44

45 **GENERAL**

46 Provide disconnect switches for loads required by code. Review HVAC and Plumbing specifications to determine what
47 equipment is furnished with disconnect switches. Install disconnect switches whether furnished under this contract or
48 not. It is the Electrical Contractors responsibility to determine the need for a disconnect switch for each load. The
49 contractors shall include in their bid the code required disconnect switches whether indicated on the drawings or not.
50

51 **PART 2 - PRODUCTS**
52

53 **DISCONNECT SWITCHES**

54 Fusible Switch Assemblies (use only when overcurrent protection is required): NEMA Type Heavy Duty; quick-make,
55 quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening
56 front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: designed to accommodate Class R,
57 Class J or Class CC (motors) cartridge type fuses.
58

1 Nonfusible Switch Assemblies: NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife
2 switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle
3 lockable in OFF position.

4
5 Enclosure:

6 Indoor: NEMA 1 code gauge steel with rust inhibiting primer and baked enamel finish.

7
8 Outdoors: NEMA 3R code gauge zinc coated steel with baked enamel finish or NEMA 4 when indicated on
9 drawings.

10
11 Provide manufacturer's equipment ground kit in all disconnect switches.

12
13 In applications where the switch serves as the service entrance disconnect, provide service ground kit, label as service
14 disconnect and provide UL listing for service disconnect.

15
16 **FUSES**

17 Fuses 600 Amperes and Less: Dual element, time delay, 600 volt, UL Class RK 5. Interrupting Rating: 200,000 rms
18 amperes.

19
20 Fuses 30 Amperes and less: Time-Delay, 600 volt, UL Class CC. Interrupting rating: 200,000 rms amperes.

21
22 Provide three (3) spares of each size and type fuse.

23
24 **PART 3 - EXECUTION**

25
26 **INSTALLATION**

27 Install disconnect switches where indicated on Drawings or required by NEC.

28
29 Provide identification as specified in Section 26 05 53.

30
31 Provide label on inside of disconnect cover identifying the type and size of fuse to be utilized.

32
33 **END OF SECTION**

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SECTION 26 51 13
INTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

SCOPE

The work under this section includes interior luminaires and accessories, exit signs, and building-mounted exterior lighting. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Submittals
- Operation and Maintenance Data
- Extra Materials
- Definitions

PART 2 - PRODUCTS

- Interior Luminaires and Accessories
- LED Luminaires
- LED Drivers

PART 3 - EXECUTION

- Installation
- Adjusting and Cleaning
- Interface with Other Products
- Zero-to-10V Dimming Control Wiring Installation
- Field Quality Control
- Luminaire Connections

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 27 26 – Wiring Devices

REFERENCE STANDARDS

- RoHS – Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
- LM-79-08 (or latest) – IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
- LM-80-08 (or latest) – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- TM-21-11 (or latest) – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
- NEMA SSL 1-2010 (or latest) – Electronic Drivers for LED Devices, Arrays, or Systems.

SUBMITTALS

Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.

For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:

- Luminaire:
 - Manufacturer and catalog number,
 - Type (identification) as indicated on the plans and schedule,
 - Delivered lumens,
 - Input watts,
 - Efficacy,

- 1 ○ Color rendering index.
- 2 • Driver:
- 3 ○ Manufacturer and catalog number,
- 4 ○ Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
- 5 ○ Power Factor, Crest Factor, THD, etc.
- 6

7 **OPERATION AND MAINTENANCE DATA**

8 All operations and maintenance data shall comply with the submission and content requirements specified under
9 section GENERAL REQUIREMENTS.

10

11 **EXTRA MATERIALS**

12 Provide three (3) percent of each lamp type, but not less than one (1) of each type.

13

14 Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LED's are integrated into the
15 luminaire and are not separate components, provide one (1) of each of these types of luminaires.

16

17 Provide one (1) LED driver or ballast of each type.

18

19 **DEFINITIONS**

20 Driver: The power supply used to power LED luminaires, modules, or arrays.

21

22 L70, L₇₀, or L_{70%}: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the
23 LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.

24

25 LED's: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays,
26 complete with driver.

27

28 LED luminaire failure: Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

29

30 **PART 2 - PRODUCTS**

31

32 **INTERIOR LUMINAIRES AND ACCESSORIES**

33 See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Luminaires manufactured by
34 others are equally acceptable provided they meet or exceed the performance of the indicated luminaires, meet the
35 intent of the design, and are approved by the A/E prior to bid.

36

37 Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).

38

39 Provide luminaires with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

40

41 **LED LUMINAIRES**

- 42 • LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria.
43 This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List,
44 but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall
45 meet for each Application Category are:
 - 46 ○ Minimum Light Output.
 - 47 ○ Zonal Lumen Requirements.
 - 48 ○ Minimum Luminaire Efficacy.
 - 49 ○ Minimum CRI.
 - 50 ○ L70 Lumen Maintenance.
 - 51 ○ Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED
52 components.

53 *Additional requirements:*

- 54 • Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans.
55 The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
- 56

- 1 • Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to
2 achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a
3 maximum 5-step MacAdam Ellipse binning process.
- 4 • Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen
5 Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
- 6 • Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- 7 • Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- 8 • Light output of the LED system shall be measured using the absolute photometry method following IES LM-
9 79 and IES LM-80 requirements and guidelines.
- 10 • Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- 11 • Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- 12 • Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
- 13 • Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of
14 70 for exterior luminaires.
- 15 • LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED
16 for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall
17 be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior
18 luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
- 19 • Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- 20 • Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across
21 specified voltage range.
- 22 • All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the
23 event connections are reversed or shorted during the installation process.
- 24 • All luminaires shall be provided with knockouts for conduit connections.
- 25 • The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and
26 driver(s).
- 27 • Provide all of the following data on submittals:
- 28 o Delivered lumens
- 29 o Input watts
- 30 o Efficacy
- 31 o Color rendering index.
- 32
- 33 *LED Luminaires used for Emergency Egress Lighting:*
- 34 • The failure of one LED shall not affect the operation of the remaining LEDs.
- 35
- 36 *Emergency LED Luminaire Compatibility with Inverters:*
- 37 • Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer
38 that the luminaire will function with a square-wave inverter.
- 39

40 **LED DRIVERS**

41 General:

- 42 • Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire
43 schedule on the drawings.
- 44 • Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- 45 • Driver shall have a rated life of 50,000 hours, minimum.
- 46 • Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- 47 • Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input
48 power and across specified voltage range.
- 49 • Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- 50 • Driver shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across
51 specified voltage range.
- 52 • Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
- 53 • Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either
54 fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- 55 • Provide all of the following data on submittals:
- 56 o Input watts
- 57 o Power Factor (pf)

- 1 ○ Crest Factor (cf) at full input power
- 2 ○ Total Harmonic Distortion (THD).

3
4 **Dimming Drivers:**

- 5 • LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable
6 drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
- 7
8 • Continuous Dimming Drivers: LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the
9 Luminaire Schedule on the plans without visible flicker or “popcorn effect”. “Popcorn effect” is defined as
10 the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the
11 pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

12
13
14 **PART 3 - EXECUTION**

15
16 **INSTALLATION**

17 Verify ceiling types with Architectural plans or with existing ceilings. Verify specified luminaires are compatible with
18 specified ceiling type(s) prior to ordering luminaires.

19
20 Install in accordance with manufacturer’s instructions.

21
22 Install suspended luminaires using aircraft cable, or pendants supported from swivel hangers. Heavy duty chain
23 supports may be used where indicated on the luminaire schedule. Provide aircraft cable, pendants, or chain lengths
24 required to suspend luminaire at indicated height. All aircraft cables or pendant supported luminaires shall have an
25 independent support to structure at all cable or pendant support locations. When chain is used, tie-wrap the
26 luminaire whip to the chain.

27
28 Support luminaires larger than 2 x 4 foot (600 x 1200 mm) size independent of ceiling framing.

29
30 Provide independent support for all luminaires over 50 lbs.

31
32 Locate ceiling luminaires as indicated on reflected ceiling plan.

33
34 Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other.
35 Secure to prohibit movement.

36
37 The Contractor shall install luminaire supports as required. Luminaire installations with luminaires supported only by
38 insecure boxes will be rejected. It shall be the Contractor’s responsibility to support all luminaires adequately,
39 providing extra steel work for the support of luminaires if required. Any components necessary for mounting
40 luminaires shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.

41
42 Install recessed luminaires to permit removal from below.

43
44 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire
45 rating.

46
47 Install code required hardware to secure recessed grid-supported luminaires in place.

48
49 Install wall mounted luminaires and exit signs at height as scheduled. Use pendants supported from swivel hangers in
50 exposed ceiling/structure locations where necessary to mount exit signs at the specified height.

51
52 Install accessories furnished with each luminaire.

53
54 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions
55 within luminaire.

56
57 Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

58
59 Install specified lamps in each luminaire and exit sign.

- 1 Dimmed luminaire circuits shall have separate neutrals.
2
3 Dimmed LED luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the
4 luminaires don't "glow" at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other
5 means acceptable to A/E.
6
7 All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the
8 project. Lamps shall be taken directly from the cartons and installed in the luminaire with special care so that they do
9 not become dusty and are not soiled in the operation.
10
11 All new lamps shall be operational at the Substantial Completion of the project.
12

13 **ADJUSTING AND CLEANING**

- 14 Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from
15 installed luminaires.
16
17 Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.
18
19 Touch up luminaire finish at completion of work.
20

21 **INTERFACE WITH OTHER PRODUCTS**

- 22 Interface with air handling accessories furnished and installed under Division 23.
23
24 Provide controls as indicated on the plans. Refer to section 26 27 26 - Wiring Devices. Controls shall be compatible
25 with the luminaires/ballasts/drivers being installed.
26

27 **ZERO-TO-10V DIMMING CONTROL WIRING INSTALLATION**

- 28 Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept separate
29 from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of Different Systems
30 does not apply to Class 2 conductors per NEC 300.3(C)(1), Informational Note No.1.
31
32 Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or conduit
33 stub for the 0-10V control wiring.
34
35 The 0-10V wiring may be routed in free air if:
36
 - 37 • The room is approximately 900 sq.ft. or less,
 - 38 • The 0-10V wiring stays within the room,
 - 39 • The ceiling space is a non-plenum space, and
 - 40 • All splices of 0-10V wiring are spliced in a box.
 - 41 • The 0-10V wiring may be tie-wrapped to the outside of the luminaire fixture whip per NEC 300.11(B)(2). Tie-
 - 42 wraps shall be UL listed for UV resistance.

- 43 At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used for the
44 line-voltage power and the 0-10V wiring. The EC shall use an NM cable connector at the opening for the 0-10V wiring.
45 Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum separation of 6 mm
46 (0.25 in.) per NEC 725.136(D).
47

48 **METAL-CLAD (MC) CABLE**

- 49 Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for the luminaire
50 wiring within a single room. Examples of such products are Encore Wire® MC-LED™ or Southwire® MC-PCS Duo™.
51 Manufacturer's names and catalog numbers are used for quality and performance only. MC Cables manufactured by
52 others shall be equally acceptable provided they meet or exceed in performance and quality as specified.
53

54 **FIELD QUALITY CONTROL**

- 55 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
56

57 **LUMINAIRE CONNECTIONS**

- 58 Recessed, including Master-Satellite connections:

- 1 • Use a luminaire fixture whip from a J-box for recessed lay-in luminaires. Luminaire fixture whips shall be
2 aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC).
3 • Cable/Conduit whips shall be 3/8" (10 mm) minimum diameter, six feet (1.8 m) maximum length.
4 • Flexible whips or pre-wired systems between master and satellite luminaires may be supported by the
5 ceiling grid wires.
6 • The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or
7 snap-in connector type, including those used on the master-satellite units.
8

9 Chain or Cable Hung (unfinished spaces):

- 10 • Use manufacturer's SO cord or a luminaire fixture whip from a J-box. Luminaire fixture whips shall be
11 aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC).
12 • Conduit whips shall be 3/8" (10 mm) minimum diameter. Conduit whip or SO cord shall be cut to length (six
13 feet (1.8 m) maximum) and shall allow movement of the chain/cable/luminaire, but shall not be long
14 enough to "loop" and shall present a neat and workmanlike appearance.
15 • Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
16 • The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or
17 snap-in connector type, including those used on the master-satellite units.
18 • Conduit whip slack shall be tie-wrapped to the chain supports. Tie-wraps shall be UL listed for UV resistance.
19

20 Cable Hung (finished spaces):

- 21 • Use manufacturer's SO cord from luminaire to a J-box.
22 • SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the cable/luminaire,
23 but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
24 • SO cord slack may be tie-wrapped to the cable supports. Tie-wraps shall be UL listed for UV resistance.
25 • Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
26

27 Surface Mounted (unfinished spaces):

- 28 • Provide direct conduit and box connection.
29

30 Surface Mounted (finished spaces):

- 31 • Provide direct conduit and box connection. Use surface metal raceway where indicated on drawings.
32 Conceal box and conduit where appropriate. Flexible metal conduit shall not be used where it is exposed.
33
34

END OF SECTION

**SECTION 27 00 05
STRUCTURED COMMUNICATIONS CABLING**

1
2
3
4 PART 1 GENERAL ERROR! BOOKMARK NOT DEFINED.
5 1.1 SCOPE OF WORK ERROR! BOOKMARK NOT DEFINED.
6 1.2 SUMMARY ERROR! BOOKMARK NOT DEFINED.
7 1.3 DATA AND VOICE COMMUNICATIONS CONTRACT WORK 2
8 1.4 SUBMITTALS ERROR! BOOKMARK NOT DEFINED.
9 1.5 APPROVED CONTRACTOR QUALIFICATIONS 3
10 1.6 APPROVED PRODUCT MANUFACTURERS ERROR! BOOKMARK NOT DEFINED.
11 1.7 PRODUCT SUBSTITUTIONS 3
12 1.8 QUALITY ASSURANCE 3
13 1.9 DRAWINGS ERROR! BOOKMARK NOT DEFINED.
14 1.10 APPLICABLE STANDARDS, CODES, AND REGULATIONS 4
15 1.11 MAINTENANCE 5
16 1.12 DOCUMENTATION ERROR! BOOKMARK NOT DEFINED.
17 1.13 WARRANTY 6
18 1.14 MOVES, ADDS AND CHANGES 7
19 1.15 CLEANUP ERROR! BOOKMARK NOT DEFINED.
20 PART 2 PRODUCTS ERROR! BOOKMARK NOT DEFINED.
21 2.1 WORK AREA CONNECTORS ERROR! BOOKMARK NOT DEFINED.
22 2.2 FACE PLATES ERROR! BOOKMARK NOT DEFINED.
23 2.3 CABLE ERROR! BOOKMARK NOT DEFINED.
24 2.4 CONNECTORS – FIBER OPTIC ERROR! BOOKMARK NOT DEFINED.
25 2.5 PATCH PANELS – CATEGORY 6 ERROR! BOOKMARK NOT DEFINED.
26 2.6 RACKS – FREE STANDING – 2 POST 9
27 2.7 CABLE MANAGEMENT – VERTICAL CABLE MANAGEMENT 10
28 2.8 CABLE MANAGEMENT – HORIZONTAL ERROR! BOOKMARK NOT DEFINED.
29 2.9 INNER-DUCT ERROR! BOOKMARK NOT DEFINED.
30 PART 3 EXECUTION ERROR! BOOKMARK NOT DEFINED.
31 3.1 APPROVED CONTRACTOR RESPONSIBILITIES 11
32 3.2 DELIVERY, STORAGE AND HANDLING LOGISTICS 11
33 3.3 PREPARATION – ERROR! BOOKMARK NOT DEFINED.
34 3.4 INSTALLATION ERROR! BOOKMARK NOT DEFINED.
35 3.5 LABELING ERROR! BOOKMARK NOT DEFINED.
36 3.6 TESTING ERROR! BOOKMARK NOT DEFINED.
37
38

39 **PART 1 – GENERAL**

40
41 **1.1. SCOPE OF WORK**

- 42 A. This Document specifies the City of Madison for product design, performance, and quality assurance, and
43 contractor responsibilities for execution of work to install a complete Category 6 structured cabling system.
44 Execution of work includes delivery and storage of materials, preparation, installation, field-testing, and project
45 completion tasks. System certification and warranty submittal requirements for completed work and future
46 moves, additions and changes (MAC's) are also specified in this document. Compliance to applicable codes,
47 standards and regulations is required for all construction work performed.
48

49 **1.2. SUMMARY**

- 50 A. Section includes products and execution requirements pertaining to Division 27 systems. Copper and fiber
51 backbone and horizontal cabling along with support systems are covered under this document.
52 B. Product specifications, general design considerations, and installation guidelines are provided in this document.
53 Quantities for all cabling products shall be provided as required to complete cabling to all work areas as shown
54 on floor plans.
55 C. The Approved Contractor shall furnish, supply and install a complete Category 6 cabling infrastructure specified
56 in the contract documents.

- 1 D. The Approved Contractor shall furnish, supply and install a complete Category 6 cabling infrastructure specified in
- 2 the contract documents.
- 3 E. Work shall include all detailed execution requirements, such as preparation, installation, system certification,
- 4 and project closeout activities according to the contract.
- 5 F. Substitutions: No substituted products shall be installed except with written approval by Owner.
- 6

7 **1.3. DATA AND VOICE COMMUNICATIONS CONTRACT WORK**

- 8 A. General
- 9 1. Furnish all labor, materials, tools, equipment and services for the installation in accordance with general
- 10 provisions of specifications and the Contract Drawings.
- 11 2. Report percentage of work completed on a monthly basis.
- 12 3. Completely coordinate with work of all other trades.
- 13 4. Provide all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary
- 14 for a sound, secure and complete installation, whether or not specifically indicated in the Contract
- 15 Documents.
- 16 5. Provide labor for testing horizontal and backbone cabling.
- 17 6. Provide Firestopping.
- 18 7. Provide Telecommunications grounding and bonding.
- 19 B. Provide complete installation for Structured Telecommunications Cabling System including but not limited to:
- 20 1. Category 6 and 6A UTP horizontal cables.
- 21 2. Singlemode optical fiber backbone cables.
- 22 3. Work area telecommunication outlets.
- 23 4. Wall mounted voice outlets.
- 24 5. Equipment mounting racks and rack enclosures.
- 25 6. Category 6 and 6A modular patch panels.
- 26 7. Optical fiber patch panels.
- 27 8. Optical fiber LC connectors.
- 28 9. Wire management panels.
- 29 10. Field testing.
- 30 11. Firestopping.
- 31

32 **1.3. SUBMITTALS**

- 33 A. Submittals shall be complete and at one time. Partial submittals will not be considered.
- 34 B. Material lists, schedule of values, lists of subcontractors, and proof of Contractor qualifications shall be provided
- 35 to Engineer upon request and shall follow the guidelines as stated in the General Requirements (Division 1 of the
- 36 specification).
- 37 C. Shop drawings shall be submitted. All communication system shop drawings shall include:
- 38 1. Manufacturer's data (specifications, "cut sheets").
- 39 2. Wiring diagrams for all installed cabling.
- 40 3. Equipment rack/cabinet layouts.
- 41 4. Proposed labeling schemes and labeling method.
- 42 5. List of cabling distances (typical and maximum) for all structured cabling
- 43 6. Submit copies of certifications for all technicians and the project manager who will support this project.
- 44 The certifications shall include:
- 45 a. Structured Cabling and termination equipment installation certifications for copper and optical
- 46 fiber connectivity and cabling.
- 47 b. Approved manufacturer classes satisfactorily completed.
- 48 7. Contractor shall submit a test plan that defines the tests required to ensure that the system meets
- 49 technical, operational, and performance specifications 45 days prior to proposed test date.
- 50 8. Work shall not proceed without the Owner's approval of the submitted items.
- 51 D. Drawings & Inspection of Site:
- 52 1. Communications floor plan drawings are to scale and typically are not dimensioned. The Contractor shall
- 53 not scale drawings for equipment placement and clearances. Dimensions given on drawings shall always
- 54 take precedence over scaled drawings.
- 55 2. Any existing wires, utilities, or equipment shown on the drawings are shown for general information and
- 56 to the best knowledge of the Engineer. The Contractor shall field verify all existing wires, utilities, or
- 57 equipment.

- 1 3. The Contractor shall field verify distances and equipment placements coordinating locations with other
- 2 trades, construction managers, and general Contractor prior to installation.
- 3 4. The Contractor shall review all site conditions prior to submitting a bid on this project. Any obvious
- 4 discrepancies between the site conditions and bidding documents shall be brought to the attention of
- 5 the Engineer at the time of bidding so clarification can be made by addendum.
- 6 5. Change order requests for additional costs related to the contractors misunderstanding related to the
- 7 amount of work involved and lack of knowledge related to the site conditions will not be allowed.
- 8 E. Test Reports: Submit copies of complete reports of all testing performed to the General Contractor, with copies
- 9 to the Architect's Electrical Engineer upon completion of job.

10
11 **1.5. APPROVED CONTRACTOR QUALIFICATIONS**

- 12 A. The Contractor shall have experience in the installation and testing of similar systems as specified herein and
- 13 shall have completed at least two projects of similar size and scope within the last 24 months. The Contractor
- 14 shall provide references upon request (including the project name, address, date of implementation, client
- 15 name, title, telephone number, and project description.”
- 16 B. All members of the installation team must be certified by the manufacturer as having completed the necessary
- 17 training to complete their part of the installation. All personnel shall be adequately trained in the used of such
- 18 tools and equipment as required.
- 19 C. The Contractor bidding on communication systems specified herein shall be certified by the connectivity
- 20 Manufacturer to install, service, and warranty the specified product prior to the time of bid and throughout the
- 21 duration of the installation. Manufacturer certifications shall not be project specific and should be valid for any
- 22 and all projects completed by Contractor.
- 23 D. The Contractor shall own and maintain tools, installation equipment, and test equipment necessary for
- 24 successful installation and testing of optical and Category 6 & 6A premise distribution systems.
- 25 E. The Owner reserves the right to require the Contractor to remove from the project any such employee the
- 26 Owner deems to be incompetent, careless or insubordinate.
- 27 F. The Contractor must maintain a state Contractor’s license as required by the state.

28
29 **1.6. APPROVED PRODUCT MANUFACTURERS**

- 30 A. The manufacturer of the Connectivity products specified in this document, as required for construction of the
- 31 cabling Infrastructure per contract documents shall be:
- 32 1. Hubbell Premise Wiring
- 33 B. The manufacturer of the Cabling products specified in this document, as required for construction of the copper
- 34 cable Infrastructure per contract documents shall be:
- 35 1. Mohawk cable
- 36 C. The manufacturer of the fiber optic cabling products specified in this document, as required for construction of
- 37 the Fiber Optic cable per contract documents shall be:
- 38 1. Mohawk Cable or Equal
- 39 D. Product substitutions are permitted under the conditions stated below. (1.7 A).

40
41 **1.7. PRODUCT SUBSTITUTIONS**

- 42 A. Product substitutions from other manufacturers shall require the approval of the owner or owner’s
- 43 representative.

44
45 **1.8. QUALITY ASSURANCE**

- 46 A. Installed category 6 balanced UTP and fiber cabling systems, pathways and distribution facilities shall adhere to
- 47 manufacturer’s instructions, contract drawings and specifications, and applicable codes, standards and
- 48 regulations.
- 49 B. Installed category 6 balanced UTP cabling systems and field test results shall strictly adhere to requirements of
- 50 ANSI/TIA/EIA-568-C.0 and ANSI/TIA/EIA-568-C.2.
- 51 C. Installed optical fiber cabling systems and field test results shall strictly adhere to requirements of ANSI/TIA/EIA-
- 52 568-C.0 and ANSI/TIA/EIA-568C.3.
- 53 D. Where applicable, all equipment, components, accessories and hardware shall be UL listed for the intended
- 54 purpose of the installation.
- 55 E. Installed products shall be manufactured by an ISO 9001 certified facility.
- 56 F. Installed products shall be free from defects in material or workmanship from the manufacturer and shall be of
- 57 the quality indicated.

- 1 G. All methods of construction that are not specified in the contract documents shall be subject to control and
- 2 approval by the Owner or Owner's Representative.
- 3 H. Installed products shall be lot-traceable by date code.
- 4 I. All critical internal manufacturing operations for installed products shall have documented in-process inspection
- 5 and testing according to ISO9001.
- 6

7 **1.9. DRAWINGS**

- 8 A. Approved or preliminary contract drawings furnished at the time of bid solicitation shall serve as the basis for
- 9 product selection, creation of bills of material, and determination of labor content.
- 10 B. Changes, additions, or deletions to contract drawings prior to awarding of the contract, shall require an
- 11 amendment to the original bid.
- 12 C. Prior to submitting the bid, in reviewing the contract drawings, the Approved Contractor shall:
- 13 1. Request the attention of the Engineer, Owner, or Design Agency to clarify any materials, apparatus or
- 14 work believed to be incorrect, inadequate, omitted, or in violation of applicable codes, standards or
- 15 regulations.
- 16 2. Note any contingencies related to unknown aspects of any drawings or specifications.
- 17 D. Contract drawings, prior to execution of the project shall be formally approved and released by the Engineer or
- 18 Design Agency and shall be approved by the Owner or Owner's Representative.
- 19 E. Execution of work shall be according to approved drawings, in addition to applicable specifications and
- 20 contractual obligations.
- 21

22 **1.10. APPLICABLE STANDARDS, CODES, AND REGULATIONS**

- 23 A. Installation Standards: Cable installation shall comply with the following:
- 24 1. American National Standards Institute, (ANSI)
- 25 2. ANSI/TIA-568-C.0, "Generic Telecommunications Cabling for Customer Premises", published 2009
- 26 3. ANSI/TIA-568-C.1, "Commercial Building Telecommunications Cabling Standard", published 2009
- 27 4. ANSI/TIA-568-C.2, "Balanced Twisted-Pair Telecommunication Cabling and Components Standard",
- 28 published 2009
- 29 5. ANSI/TIA-568-C.3, "Optical Fiber Cabling Components Standard", published 2008, errata issued in
- 30 October, 2008
- 31 6. ANSI/TIA-568-C.4, "Coaxial Cabling Component Standard" Published 2010
- 32 7. ANSITIA/EIA-569-B, Commercial Building Standards for Telecommunications Pathways and Spaces, 2003.
- 33 8. ANSI/TIA-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications,
- 34 2010.
- 35 9. ANSI/TIA/EIA-942, Telecommunications Infrastructure for Data Centers, 2004.
- 36 10. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable, 2001.
- 37 11. ANSI/TIA/EIA-598, Color Coding of Optical Fiber Cables, 2001
- 38 12. ANSI/ICEA S-87-640, Fiber Optic Outside Plant Distribution Cable, 1999.
- 39 13. ANSI/TIA/EIA-492AAAC, Detail Specification for 850nm Laser-Optimized 50um Core Diameter/125 um
- 40 Cladding Diameter Class 1A Graded Index Multimode Optical Fibers, 2003.
- 41 14. ANSI/TIA/EIA-492CAAA, Detail Specification for Class Iva Dispersion-Unshifted Singlemode Optical fibers,
- 42 2002.
- 43 15. ANSI/TIA/EIA-758: Customer-Owned Outside Plant Telecommunications Cabling Standard, 2004.
- 44 16. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Singlemode Fiber Plant: OFSTP-7,
- 45 2002.
- 46 17. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Plant: OFSTP-
- 47 14A, 2003.
- 48 18. ANSI/TIA/EIA-TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning,
- 49 2001.
- 50 19. ANSI/TIA/EIA-TSB-140, Additional Guidelines for Field Testing Length, Loss, and Polarity of Optical Fiber
- 51 Cabling Systems, 2004.
- 52 20. ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure, 2002.
- 53 21. ANSI/EIA-310-D, Cabinets, Racks, Panels, and Associated Equipment, 1992.
- 54 22. ANSI/TIA/EIA-604 (Series), FOCIS Fiber Optic Connector Intermateability Standard, 2000-2003.
- 55 23. National Fire Protection Association, Inc., NFPA 70
- 56 24. National Electric Code (NEC), 2005.
- 57 25. NEC Article 250: Grounding
- 58 26. NEC Article 386: Surface Metal Raceways

- 1 27. NEC Article 388: Surface Non-Metallic Raceways
- 2 28. NEC Article 800: Communications Circuits
- 3 29. NEC Article 770: Optical Fiber Cables and Raceway
- 4 30. Underwriter’s Laboratory, Inc. (UL)
- 5 31. UL-5A: Standard for Non-Metallic Raceways and Fittings
- 6 32. UL-5: Standard for Surface Metal Raceways and Fittings
- 7 33. UL-5C: Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits
- 8 34. UL-50: Standard for Enclosures for Electrical Equipment
- 9 35. UL-94-V0: Tests for Flammability of Plastic Materials
- 10 36. UL-498: Attachment Plugs and Receptacles
- 11 37. UL-1479: Fire Tests of Through-penetration Firestops (in Accordance with ASTM E814).
- 12 38. UL-1863: Standard for Safety of Communications Circuit Accessories
- 13 39. National Electrical Manufacturer’s Association (NEMA)
- 14 40. ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements
- 15 41. NEMA 250-2003: Enclosures for Electrical Equipment
- 16 42. ISO/IEC 11801, Ed. 2:2002, Information Technology – Generic Cabling for Customer Premises, 2002.
- 17 43. ISO/IEC 18010, Information Technology – Pathways and Spaces for Customer Premises Cabling, 2005.
- 18 44. ISO/IEC 14763-1, Information Technology – Implementation and Operation of Customer Premises Cabling
19 – Part 1: Administration, 2004.
- 20 45. CSA C22.1-06, Canadian Electric Code (CEC), 2006
- 21 46. Federal Communications Commission (FCC) Title 47, Code of Federal Regulations, Part 68: Connection of
22 Terminal Equipment to the Telephone Network, 1998.
- 23 47. U.S. Public Law 336. 101st Congress, ADA: Americans with Disabilities Act of 1992.
- 24 48. IEEE 802.3af, Data Terminal Equipment (DTE) Power Over Media Dependent Interface (MDI), 2003.
- 25 49. IEEE 802.3at (current draft), Data Terminal Equipment (DTE) Enhanced Power Over Media Dependent
26 Interface (MDI).
- 27 50. IEEE 802.3ae, Specification for 10 Gbit/s Ethernet Operation over Optical Fiber.
- 28 51. Telecommunications Distribution Methods Manual, 11th Ed., Building Industry Consulting Services
29 International (BICSI), 2006.
- 30 52. Information Transport Systems Installation Manual, 4th Ed., Building Industry Consulting Services
31 International (BICSI), 2004.
- 32 B. This document is not a substitute for any code, standard or regulation. The Approved Contractor must be aware
33 of local codes that may impact the bid submittal or execution of the project. The current revision of any
34 applicable code, standard, or regulation shall take precedence at the point of project execution, unless otherwise
35 recognized by local authorities. Applicable standards or codes that affect construction, which are listed as
36 normative references within any governing document, are also the responsibility of the Approved Contractor for
37 compliance.
- 38 C. Materials
- 39 1. All materials shall be UL or ETL listed and verified and shall be marked as such.
- 40 2. Products shall be regularly catalogued items of the manufacturer and shall be supplied as a complete unit
41 in accordance with the manufacturer's standard specifications with any optional items required for
42 proper installation unless otherwise noted.
- 43 3. Material shall be delivered to the site in the original packing.

44
45 **1.11. MAINTENANCE**

- 46 A. All materials used on this project shall be new. Used and refurbished equipment is not permitted unless
47 approved by CITY OF MADISON. Provide equipment to site in original packaging whenever practical.
- 48 B. The Contractor is responsible for scheduling all deliveries and providing proper receipt, handling, and storage of
49 all materials. Protect all equipment from physical damages (dents, scratches, dust, water, paint, chemicals, and
50 temperature extremes) and vandalism, or theft. The Contractor shall replace any damaged or stolen equipment.
51 The Contractor is responsible for all equipment until final project acceptance by Owner.
- 52 C. Maintenance of the cabling infrastructure is to be done by authorized personnel only or void of manufacturer’s
53 warranty may result. It is the responsibility of the owner or end user to utilize a certified installer to maintain
54 warranty coverage on existing or new cabling infrastructure.
- 55 D. The telecommunications contractor shall furnish a quotation for time and material to perform maintenance and
56 repairs. The owner has the first right of refusal of selecting suitable contractor or qualified internal personnel to
57 perform maintenance and repairs on structured cabling.

- 1 E. Additions of new cabling, either horizontal or backbone, shall be completed, tested, and documented into
- 2 permanent building records. New cabling installations intended to be covered by the manufacturer's warranty
- 3 shall adhere to the documentation submittal and system certification provisions stated above.
- 4 F. The Contractor is responsible for cleaning the worksite every business day and remove debris from the facility.
- 5

6 **1.12. DOCUMENTATION**

7 A. TEST RESULTS

- 8 1. All test results are to be saved electronically on CD. Test documentation submitted on disk shall be
- 9 clearly marked on the cover with the words "Project Test Documentation", the project name, and the
- 10 date of completion (month and year). For multiple buildings, the building name, including floor or wing
- 11 I.D. should also be included on the test results disk.
- 12 2. File names of the test results recorded for each link shall match the official identification. Test results
- 13 shall include a complete record for each link, including type of test, cable type, cable/port I.D.,
- 14 measurement direction, reference setup, date, and technician's name(s).
- 15 3. The test equipment name, manufacturer, model number, serial number, software version and last
- 16 calibration date shall also be provided in the test results documentation.
- 17 4. When repairs and re-tests are performed, the problem cause and corrective action taken shall be noted,
- 18 and both the failed and passed test data shall be documented.
- 19 5. The owner, engineer, lead project manager, or owner's representative reserve the right to request
- 20 verification of test results with a re-test of installed cables, on a sampling basis. Re-testing shall be at the
- 21 expense of the installer unless otherwise noted in the contract documents.

22 B. AS BUILT DRAWINGS

- 23 1. Deviations from the approved drawings, whether or not a change order is submitted, shall be clearly
- 24 denoted as built on the working hard copy drawing by the telecommunications contractor. As-built
- 25 drawings shall be returned promptly to the owner or design agent for completion of drafting revisions to
- 26 the original design. See "Documentation – Change Orders" below. Manufacturer's warranty
- 27 registrations may also require as-built drawings.
- 28 2. Floor plan drawings shall at minimum include detailed cable and pathway layouts, exact locations of
- 29 workstation outlets, and cable distribution hardware locations. Workstation outlets shall have
- 30 alphanumeric identifiers on the drawings as specified by the end user or owner.

31 C. CHANGE ORDERS

- 32 1. Any deviation from the approved contract drawings or specifications shall be submitted as a written
- 33 change order.
- 34 2. Execution of work, to perform changes, shall not proceed without prior written approval. Any changes
- 35 done without written approval will be at no cost to CITY OF MADISON. If the work is shown to be
- 36 incorrect the contractor will have to correct the problem at no cost to CITY OF MADISON.
- 37 3. Significant changes may require a written quotation of additional labor and materials from the
- 38 telecommunications contractor.
- 39 4. It is the responsibility of the owner or owner's representative to bear the added cost of any substantial
- 40 cabling system design changes. The contractor will not proceed with any change orders without written
- 41 approval by the owner's representative. Any changes not approved by the owner's representative will be
- 42 responsibility of the contractor and at no cost to CITY OF MADISON.
- 43 5. Field changes that are completed without issuance of revised drawings shall be clearly denoted on the
- 44 working as-built drawing. Refer to "As-Built Drawings" above.

45 D. PUNCH LISTS AND CORRECTIVE ACTION

- 46 1. As required in the contract documents, the telecommunications contractor shall correct punch-lists items
- 47 determined to be in violation of drawings, specifications, codes, standards or regulations.
- 48 2. The contractor shall be responsible for timely re-work of faulty cabling or hardware installations.
- 49 3. The owner reserves the right to withhold final payment until punch list items are resolved satisfactorily.
- 50

51 **1.13. WARRANTY**

- 52 A. THE CITY OF MADISON requires a Permanent Link warranty for the project. Manufacturer requires Permanent
- 53 Link Test.
- 54 B. The length of the extended warranty shall be a minimum of twenty-five (25) years.
- 55 C. Warranty covering all components, equipment and workmanship shall be submitted in writing with system
- 56 documentation.
- 57 D. The warranty period shall begin on the system's first use by the owner.

- 1 E. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or
- 2 faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to
- 3 the Owner.
- 4 F. Upon Completion of the project the Telecommunication Contractor shall forward the signed Warranty
- 5 Registration Form and warranty certificate to the Owner.
- 6 G. The manufacturer warrants category 6 cabling, category 6A cabling, optical fiber cabling and connecting
- 7 components free of defects in material or workmanship.
- 8 H. Category 6, category 6A and optical fiber cabling and components are warranted to perform the intended
- 9 application upon completion of proper installation and testing.
- 10 I. Warranty coverage includes application assurance and compliance to applicable performance specifications.
- 11 J. Installed category 6 and 6A cabling systems may be granted a full Channel warranty under the conditions stated
- 12 below.
- 13 1. A certified installer registered who has completed a Manufacturer's training program performs the
- 14 construction.
- 15 2. Contractors performing the certified installation are properly registered in the Manufacturer's warranty
- 16 program.
- 17 3. The channel components are supplied entirely by one Manufacturer, including patch cords.
- 18 4. Cable used in the installation is qualified and recognized by Connectivity Manufacturer.
- 19 5. Installed link systems are properly documented and tested with a "PASS" result. The county requires a
- 20 link test and the use of manufacturer patch cords to receive a channel warranty.
- 21 6. Field test equipment used for category 6 cabling is minimum level III classification and complies with
- 22 TIA/EIA-568-B.2 requirements.
- 23 7. Required test results, stored on a CD, and project documentation including as-built drawings, are to be
- 24 submitted to the Manufacturer by the registered contractor.

25
26 **1.14. MOVES, ADDS AND CHANGES**

- 27 A. Moves, additions and changes initiated by the owner, end user, project manager, or design agent, which are
- 28 beyond the scope of work in the original contract, shall require a revised quotation by the telecommunications
- 29 contractor.
- 30 B. It is the responsibility of the owner or owner's representative to bear the added cost of any substantial cabling
- 31 system design changes.
- 32 C. Moves, additions and changes shall either be issued in revised drawings, or otherwise shall be clearly denoted on
- 33 as-built drawings.
- 34 D. Moves, additions and changes that affect installations covered in a manufacturer's warranty shall be performed
- 35 by a certified contractor that is properly registered in the manufacturer's warranty program.

36
37 **1.15. CLEANUP**

- 38 A. The communications Contractor shall clean up all debris related to this work on a regular basis leaving the job
- 39 site in a clean, safe condition.
- 40 B. Protect all equipment from damage during construction. Equipment not protected shall be replaced at the
- 41 Contractor's expense.

42
43 **PART 2 - PRODUCTS**

44
45 **2.1. WORK AREA CONNECTORS**

- 46 A. Category 6 Jacks
- 47 1. Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant.
- 48 2. Jacks shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
- 49 3. Jacks shall terminate 26-22 AWG solid or stranded conductors.
- 50 4. Jacks shall include a dust cap for wire retention.
- 51 5. Jacks shall accept FCC compliant 6 position plugs.
- 52 6. Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
- 53 7. Category 6 jacks shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit,
- 54 form, and function.
- 55 8. Jacks shall be manufactured in the USA.
- 56 9. Category 6 jacks shall meet or exceed Category 6 transmission requirements for connecting hardware, as
- 57 specified in ANSI/TIA/EIA-568-C.2, Transmission Performance Specifications for 4-Pair 100 ohm.
- 58 10. Jacks shall be UL LISTED and CSA certified.

- 1 11. Colors to specified by end user
- 2 12. Category 6 modular jacks, as specified in the Contract Documents, shall be:
- 3 a. Hubbell
- 4 b. HXJ6EI (Category 6 – Ivory)
- 5

6 **2.2. FACE PLATES**

- 7 A. Rear loading w/designation window
- 8 1. Faceplates shall be constructed of high impact, UL94 V-0 rated thermoplastic.
- 9 2. Faceplates shall be compatible with standard NEMA openings and boxes.
- 10 3. Faceplates shall be 2.75" W x 4.5" H (69.8 mm x 114.3 mm) for single gang and 4.5" X 4.5" (114.3 X 114.3
- 11 mm) for double gang.
- 12 4. Port size in each faceplate shall fit the Category 6 Modular Jack or Snap-Fit fiber optic, audio, and video
- 13 modules for multimedia applications.
- 14 5. Faceplates shall be provided with clear plastic and color-matched label field covers. Faceplates shall
- 15 provide for ANSI/TIA/EIA-606-A compliant workstation outlet labeling.
- 16 6. #6-32 pan head Phillips/slotted mounting screws shall be included with each faceplate.
- 17 7. Faceplates shall be UL LISTED and CSA certified.
- 18 8. Work area faceplates, as specified in the Contract Documents, shall be:
- 19 a. Hubbell (IFP Series)
- 20 b. IFP14ei (4-Port Ivory)

21 **2.3. CABLE**

- 22 A. Category 6 UTP
- 23 1. Plenum - Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a
- 24 ripcord, surrounded by a tight outer jacket.
- 25 2. Non-plenum - Cable construction shall be four twisted pairs of 24 AWG insulated solid conductors, with a
- 26 ripcord, surrounded by a tight outer jacket.
- 27 3. NO minimum compliant cable will be accepted. The facility requires additional bandwidth.
- 28 4. Ripcord shall be directly underneath the outer jacket.
- 29 5. Cable shall be marked with Manufacturer and pertinent information. UL, ETL, or CSA agency certification
- 30 or verification markings shall be marked on the cable jacket according to the certifying agency's
- 31 requirements.
- 32 6. Color coding of the pairs shall be as follows:
- 33 a. Pair 1: White/Blue; Blue
- 34 b. Pair 2: White/Orange; Orange
- 35 c. Pair 3: White/Green/Green
- 36 d. Pair 4: White/Brown/Brown
- 37 7. Plenum or Riser rated jackets
- 38 8. Cable shall be supplied in 1000 ft spools or 1000 ft Reelex boxes.
- 39 9. Cable shall exceed Category 6 transmission requirements specified in ANSI/TIA/EIA-568-C.2.
- 40 10. Cable shall be UL and C (UL) listed.
- 41 11. Cable shall exceed the requirements of TIA/TSB-155: 10 Gb/s Ethernet Operation over 37 Meters Channel
- 42 Length.
- 43 12. Category 6 UTP horizontal distribution cable, as specified in the Contract Documents, shall be:
- 44 a. Mohawk AdvanceNet Cable
- 45 b. Plenum M57193
- 46 c. Riser M57202
- 47 B. Backbone distribution cable – Fiber Optic
- 48 1. Singlemode fiber backbone distribution cable shall be available in multi-strand constructions for intra-
- 49 building applications.
- 50 2. OFNR or OFNP will be determined at each site. The contractor will be responsible to assure that the
- 51 proper type of jacketing is being used. Failure to meet the local code will be cause for replacement of
- 52 cable at no expense to CITY OF MADISON.
- 53 3. Singlemode fiber shall be dispersion un-shifted fiber in compliance with ANSI/TIA/EIA-492CAAA.
- 54 4. Intra-building fiber distribution cable design shall be according to ANSI/ICEA S-83-596.
- 55 5. Singlemode backbone fiber distribution cable, when installed, shall exceed the performance
- 56 requirements of ANSI/TIA/EIA-568-C.3.
- 57 6. Singlemode optical fiber Backbone Fiber distribution cable, as specified in the Contract Documents, shall
- 58 be:

- 1 a. Mohawk Cable or equal
- 2 b. Singlemode Riser M9W042 (12 Strand) unless otherwise specified by the City of Madison.
- 3 c. Singlemode Plenum M9W048 (12 Strand) unless otherwise specified by the City of Madison.
- 4

5 **2.4. CONNECTORS – FIBER OPTIC**

- 6 A. Pre-polished fiber connector basic design shall be a factory pre-polished lc-style optical fiber connector with a
- 7 zirconium ceramic ferrule.
- 8 B. Index-matching gel is factory-injected into the cleaved fiber stub splice to minimize connector insertion loss.
- 9 C. LC Singlemode factory pre-polished connectors shall HAVE pre-installed fibers.
- 10 D. Connector materials shall be designed with thermal stability to comply with environmental requirements of
- 11 ANSI/TIA/EIA-568-B.3 and Telcordia GR-1081-CORE.
- 12 E. Pre-polished lc connectors shall require no field polishing AND REQUIRE NO ADHESIVES FOR TERMINATION.
- 13 F. Connector design and termination technique shall be independent of cable type or manufacturer, and shall be
- 14 compatible for either 900 micron buffer or 250 micron buffer distribution cables.
- 15 G. Pre-polished LC fiber connectors, when properly installed onto qualified cable, shall meet the 10 Gb/s Ethernet
- 16 performance requirements of IEEE802.3.
- 17 H. LC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental
- 18 performance requirements of ANSI/TIA/EIA-568-C.3.
- 19 I. Optical fiber horizontal distribution cable, as specified in the Contract Documents, shall be:
- 20 1. Hubbell ProClick
- 21 2. Singlemode LC – FCLC900KSM12
- 22 3. AFL (Fast)
- 23 4. Singlemode LC- fast-LC-SM
- 24

25 **2.5. PATCH PANELS – CATEGORY 6**

- 26 A. Category 6 patch panels shall be standard 8-position, RJ-45 style, un-keyed, FCC-compliant receptacle, in 24- and
- 27 48-port configurations.
- 28 B. Panel frames shall be black powder coated 14-gage steel with rolled edges top and bottom for proper stiffness.
- 29 C. Panels shall accommodate a minimum of 24 ports for each rack mount unit (1 RMU = 1.75 in.). 48 ports are
- 30 recommended.
- 31 D. Panels shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
- 32 E. Panels shall terminate 26-22 AWG solid conductors.
- 33 F. Panels shall have individual port identification numbers on the front and rear of the panel. Panels shall have the
- 34 Category 6 designation, visible from the front when installed.
- 35 G. Printed circuit boards shall be fully enclosed front and rear for physical protection.
- 36 H. Panel contacts shall accept a minimum of 2000 mating cycles without degradation of electrical or mechanical
- 37 performance.
- 38 I. Panel termination method shall follow the industry standard 110 IDC punch-down, using a standard 110 impact
- 39 termination tool.
- 40 J. Category 6 panels shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form,
- 41 and function.
- 42 K. Category 6 patch panels, when installed, shall exceed the link or channel performance requirements of
- 43 ANSI/TIA/EIA-568-C.2.
- 44 L. Category 6 patch panels shall be able to accommodate 10G in a 37 meter channel per TSB-155.
- 45 M. Category 6 patch panels, as specified in the Contract Documents, shall be:
- 46 1. Hubbell (NEXTSPEED 6 Series)
- 47 2. 24 Port - P6E24U
- 48 3. 48 Port - P6E48U
- 49

50 **2.6. RACKS – FREE STANDING – 2 POST**

- 51 A. Rack material shall be STRUCTURAL ALUMINUM with a durable black polyurethane powder coat finish.
- 52 B. Installed racks shall have a static load capacity of 500 Lbs.
- 53 C. Racks shall be available in either 19-inch or 23-inch standard rack configurations.
- 54 D. Tapped holes in the vertical rails for mounting of panels shall be #12-24 thread size. Coating shall not interfere
- 55 with thread fit.
- 56 E. Standard rack heights OF 7 ft (84 in), and have a capacity of 45 RMU.
- 57 F. Rack base angles shall be pre-drilled for floor mounting, and for assembly to vertical rails.

- 1 G. Each Rack shall be provided with, Racks shall accommodate expansion of cable capacity and added volume FOR
- 2 CATEGORY 6 cabling.
- 3 H. *NOTE:* Each basic rack delivered shall consist of: Equipment Rack, Isolation pads, 18" wide Black Ladder Rack &
- 4 mounts to secure to Rack, a vertical Electrical 20 amp Outlet strip (Minimum 6 receptacles) with Mounting
- 5 Brackets.
- 6 I. Free standing racks and accessories, as specified in the Contract Documents, shall be:
- 7 1. Hubbell (NextFrame series)
- 8 2. HPW84RR19
- 9

10 **2.7. CABLE MANAGEMENT –VERTICAL CABLE MANAGEMENT**

- 11 A. Z-channel design offers:
- 12 1. Airflow
- 13 2. Minimizes weight
- 14 3. Maximum cable capacity with unobstructed access to cable
- 15 B. Snap in Spools with ability to put them where they will do the most good.
- 16 C. Rear cable management allows cable to be run on both left and right sides, while leaving the area behind the
- 17 electronics and patch panels open for increased airflow.
- 18 D. Construction:
- 19 1. Cold Rolled steel z-channels
- 20 2. Cold rolled steel covers
- 21 E. Mounts to 84" Equipment racks
- 22 F. Channel width: 6"W
- 23 G. Vertical Cable Management and accessories, as specified in the Contract Documents, shall be:
- 24 1. Hubbell (NEXTFRAME series)
- 25 2. VS76
- 26

27 **2.8. CABLE MANAGEMENT –HORIZONTAL CABLE MANAGEMENT**

- 28 A. Horizontal management will be constructed of 14 ga cold-rolled steel (CRS)
- 29 B. Finish shall be a Durable, black powder coat.
- 30 C. Size: 2RU
- 31 D. Front Ring Depth: 3.5"
- 32 E. All steel construction - rugged, non-flammable, no fasteners to wear or break, no fingers to fuss with.
- 33 F. Modular components easily configured in field to adapt to demanding applications.
- 34 G. Hinged Front Cover - Locks in place when completely open to prevent cover from being removed or lost.
- 35 H. Horizontal Cable Management and accessories, as specified in the Contract Documents, shall be:
- 36 1. Hubbell (NEXTFRAME series)
- 37 2. HC219CE3N
- 38 I. Enclosures – fiber rack mount
- 39 1. Rack-mounted, powder coated formed cold rolled steel enclosure.
- 40 2. Swing-out or pull-out inner tray shall provide access to inner cables and connections, and maintain
- 41 proper cable bend radius throughout the range of motion.
- 42 3. Fiber rack-mount enclosures shall be a 19-inch formed/welded and powder coated modular design, sized
- 43 according to the cable installation.
- 44 4. Fiber rack-mount enclosures may serve as a main, horizontal, or intermediate cross connect facility.
- 45 5. Panel mounting brackets shall be configurable to either 19" or 23" racks per ANSI/EIA-310-D.
- 46 6. Enclosure chassis shall have two mounting bracket locations for either flush mount or center mount on
- 47 the rack.
- 48 7. Inner tray shall have a threaded mounting boss to accept a mounting stud for splice trays. Splice tray
- 49 capacity shall be (2) 10" splice trays, each with 24-splice capacities (48 splices total). Splice tray mounting
- 50 boss shall also accept a stud for mounting 1-RMU blown fiber adapter brackets.
- 51 8. Inner tray mounting posts for modular panels shall also accept 12-fiber MTP-style cassettes for "plug &
- 52 play" installations.
- 53 9. Inner tray shall have rear cable tie-down features to accept various diameter backbone cables entering
- 54 the enclosure.
- 55 10. Enclosures shall be constructed of 16 gage cold rolled steel (CRS)
- 56 11. Fiber rack-mount enclosures and accessories, as specified in the Contract Documents, shall be:
- 57 a. Clearfield – Fieldsmart fiber crossover distribution system.
- 58

- 1 J. Adapter panels – optical fiber
2 1. Optical fiber Adapter panels shall be a modular design powder coated stamped metal construction.
3 2. ADAPTER PANELS SHALL BE LC.
4 3. High or low-density versions.
5 4. Adapter panels shall have quick-release snap fasteners to fit directly into fiber enclosures.
6 5. Fiber patch panels, as specified in the Contract Documents, shall be:
7 a. Clearfield – Clearview class patch only cassette.
8

9 **2.9. INNER-DUCT**

- 10 A. Fiber Optic Cable shall be installed with Innerduct for protection of fiber cables in a shared pathway.
11 B. The inner duct will be rated for the environment that it is being installed in. Plenum and riser rated.
12 C. Three inner Ducts will be run between closets. One for current installation, two spare for future applications.
13 D. Size: 1" CORRUGATED
14 E. Flexible & Lightweight for ease of handling
15 F. Pre-threaded with pull line
16

17 **PART 3 - EXECUTION**

18
19 **3.1. APPROVED CONTRACTOR RESPONSIBILITIES**

- 20 A. The Approved Contractor shall assume the following responsibilities:
21 1. Execute construction in accordance with contract drawings and specifications.
22 2. Adhere to project schedules and job site rules.
23 3. Adhere to the quality, regulatory, logistics, and documentation requirements.
24 4. Adhere to the product requirements outlined in PART 2 above.
25 5. Adhere to the Execution guidelines outlined below.
26 6. Furnish the cabling system certification and warranty provisions outlined in this specification section.
27

28 **3.2. DELIVERY, STORAGE AND HANDLING LOGISTICS**

- 29 A. Materials delivered to the construction site shall be stored in a dry, secure area, preferably indoors. Storage
30 temperature of materials shall adhere to manufacturer's recommendations. Movement of packaged materials
31 shall be in a manner to avoid damage of contents. On-site storage, either indoors or trailer, shall have
32 permission by the owner, and shall not interfere with other construction activity.
33 B. Installation of category 6 cable shall be within the recommended temperature range specified by the
34 manufacturer. Cable installation temperature above 50F is recommended.
35

36 **3.3. PREPARATION**

- 37 A. Cable pathways and Firestops
38 1. Cable pathways, including conduit, cable tray, ladder rack, raceway, slots, sleeves, etc. shall be located
39 and mounted according to contract drawings and manufacturer's instructions. Pathways shall not be
40 installed in wet areas.
41 2. Cable pathway fill ratio, bend radius, run length, number of bends, and proximity to EMI sources shall be
42 in accordance with ANSI/TIA/EIA-569-B. Maximum cable count of the initial installation shall not exceed
43 40% fill ratio in any pathway.
44 3. In accordance with NEC 2005, power wiring and communications cabling shall not share the same
45 pathway or outlet unless separated by a physical barrier.
46 4. Cable pathways shall be secured to a structural member of the building, or permanent wall studs. Wall
47 surfaces for raceway mounting should be finished complete.
48 5. Metallic pathways shall be electrically continuous, free of sharp edges, and properly bonded to an
49 approved ground. EMI sources such as ballasts, motors, and bus conductors shall be avoided by using
50 proper separation distances.
51 6. Pathways that penetrate fire-rated barriers shall be fire stopped according to local codes and recognized
52 practices. Fire stop materials or devices shall be qualified to UL-1479, in accordance with ASTM E814.
53 Fire stop method shall have P.E. approval.
54 7. Core drilling of holes for fire-rated poke-through outlet devices shall have approval by a structural
55 engineer or P.E. on the contract drawings prior to start of work.
56 8. Pathways for vertical cable runs, such as slots and sleeves, shall be installed in the proper location in
57 accordance with applicable codes and standards.
58

- 1 B. Telecommunications rooms and equipment rooms
2 1. Telecommunications room (TR) layout, location and design shall be in accordance with the guidelines of
3 ANSI/TIA/EIA-569-B. TR's on each floor of the building should be centrally located and vertically aligned
4 to simplify backbone cable and pathway routing. TR's shall not be installed in wet areas, or near EMI
5 sources or caustic chemicals.
6 2. Layout of rack, cabinet or enclosure locations shall be according to contract drawings.
7 3. Racks and cabinets shall be secured to the floor using proper anchors and fasteners.
8 4. Mount and assemble racks, cabinets, brackets and enclosures per manufacturer's instructions. Mount
9 patch panels and cable management accessories in the specified locations.
10 5. Adjoining pathways (ladder rack, cable tray, etc.) shall be properly secured and positioned to allow
11 adequate bend radius of cables entering the rack or cabinet.
12 C. Wall outlets and recessed wall boxes
13 1. Wall outlet and cable drop pathway location shall be according to contract drawings. Guidelines from
14 ANSI/TIA/EIA-569-B should be followed for location with electrical outlets and outlet height above
15 finished floor.
16 2. Outlet boxes shall be fastened securely to a wall stud or structural element, in a manner to permit flush
17 mounting of the faceplate with the finished wall.
18 3. Multi-connect boxes shall be installed in a manner to comply with separation rules for power and
19 communications wiring in close proximity.
20 4. Refer to specific manufacturer's recommendations for wall outlet selection, cable deployment, and
21 termination of jacks into faceplates.
22 D. Surface housings and MUTOA outlets
23 1. Raceway or conduit should be deployed to the surface housing location. For through-wall cable entry,
24 cut the wall opening to match the opening in the housing base.
25 2. Lay out mounting holes onto the desired wall location. For wallboard, concrete or cinder block walls, drill
26 to the proper depth and install anchors.
27 3. Always use proper wall anchors. Installing mounting screws directly into wallboard without using
28 anchors can cause screw pullout and detachment of the surface housing. Mounting the base plate to
29 studs is recommended.
30 4. Mount base plate of surface box or MUTOA to outlet location using proper fasteners. Note: furniture and
31 wall outlet applications require mounting of base plate prior to cable pulling and connector termination.
32 5. Install cover onto base plate.
33 6. Refer to detailed manufacturer's guidelines for cable deployment and termination of jacks into surface
34 housings. Due to the larger size of category 6 cables, proper cable bend radius must be maintained.
35 Certain restrictions may apply when dressing category 6 cabling into surface housings.
36

37 **3.4. INSTALLATION**

- 38 A. Cable Support
39 1. This Contractor shall install all supports for cables specified in this section. Traditional Ladder rack will be
40 used in each telecommunications room, basket tray and j-hooks will be used in the horizontal.
41 2. Cable supports shall be spaced randomly, but no further than 5'-0" apart.
42 3. Inner-ducts will be run between each closet or telecommunications room. One for current installation
43 with three multi cells for future installations or changes. In each telecommunications room the inner-
44 ducts entering the space will be combined, in a size appropriate metallic box that is mounted on the wall.
45 The combined inner ducts will then be routed to the rack and the fiber bay.
46 4. Provide all additional cable management products, sleeves or conduit raceways as required to protect
47 exposed cabling and complete the installation of cables in a neat manner.
48 5. A horizontal conduit system consists of conduits radiating from the telecommunications room to the
49 workstation outlets in the floor, walls, ceilings, and columns of a building. When using a conduit
50 distribution system utilize the most direct route following the building lines.
51 6. The size and number of conduits or sleeves used for backbone pathways depends on the usable floor
52 space served by the backbone system. at least three 4 trade size sleeves are recommended.
53 7. Conduit is only required if building codes or environmental conditions necessitate it. Rigid or EMT metal
54 conduits are deemed suitable for building installation. Adequate planning should allow for a minimum of
55 one 1-inch conduits to each workstation location if code requires conduit for voice and data cables.
56 8. Conduit fill ratios shall not exceed 40%; contact your cable manufacturer to get recommendation on fill
57 rates.

- 1 9. No conduit run should be designed with more than two (2), 90 degree bends between pull points or pull
- 2 boxes. If a run requires more than two 90 degree bends, install a pull box.
- 3 a. Exceptions:
- 4 i. The total run is not longer than 33 feet.
- 5 ii. The conduit size is increased to next trade size.
- 6 iii. One of the bends is located within 12 inches of the cable end.
- 7 10. All conduits will be equipped with a contiguous length of plastic or nylon pull string with a minimum
- 8 rating of 200 lbs. (90 Kg)
- 9 11. A conduit run should not be designed with continuous closed sections longer than 100 ft without pull
- 10 points or pull boxes installed.
- 11 12. All conduits should terminate above or in the installed ladder racks and allow for proper cable racking.
- 12 Cable waterfalls should be considered in areas that have excessive distance between the conduit and
- 13 ladder rack.
- 14 13. Trays and conduits located within the ceiling shall protrude into the room a distance of 1 to 2 in without a
- 15 bend and above 8 ft high. Clear, unobstructed access to the ladder rack and conduits shall be provided
- 16 within telecommunications rooms.
- 17 14. Conduits entering through the floor shall terminate at least two (2) inches above the finished floor
- 18 15. Locate slot/sleeve systems in places where pulling and termination will be easy.
- 19 16. If possible, locate sleeves, slots, and/or conduits on the left side of the room; this placement enhances
- 20 the use of wall space from left to right.
- 21 17. When possible, entrance conduit and distribution conduit/cable tray should enter and exit on the same
- 22 wall; if this is not possible, ladder rack inside the room should be provided for distribution from wall to
- 23 wall.
- 24 18. All floor penetrations shall be core drilled with a maximum 1/4 inch size greater than the exterior
- 25 dimension of the riser conduit.
- 26 19. Conduits entering through a wall shall be reamed and bushed, and terminated as close as practicable to
- 27 the terminating rack or wall.
- 28 20. Terminating above a suspended ceiling must terminate not less 3 inches above finished ceiling and
- 29 finished with bushing opening.
- 30 21. All conduit will be labeled for easy identification.
- 31 22. All floor penetrations shall be at columns, exterior walls or in equipment rooms.
- 32 23. Cables shall be supported at height of bottom flange of structural beams using a rigid support method
- 33 (i.e. threaded rod, beam clamps, etc.).
- 34 24. Do not support cables from ductwork, sprinkler piping, water piping, waste piping, conduit, ceiling wire,
- 35 or other system supports.
- 36 25. The conduits or sleeve will be installed per TIA/EIA-569-B and seal all penetration with approved fire stop
- 37 product.
- 38 26. Provide independent support system for each low voltage cabling system.
- 39 B. Cable
- 40 1. Category 6 cable will be run for data. Category 6A will be run to all Wireless access points. Category 6
- 41 Gelled filled cable will be run in the backbone for all communications applications. Certain environments
- 42 may require the use of different cables and/or cable jackets.
- 43 2. **All Terminations will utilize T568B wiring in THE CITY OF MADISON facility.** Any Contractor not
- 44 complying with this wiring requirement will fix the problem at no cost to CITY OF MADISON.
- 45 3. Maximum cable lengths to be 295 feet (90 m) including service loop. Provide all necessary installation
- 46 materials, tools and equipment to perform insulation displacement type terminations at all
- 47 communications outlets, patch panels.
- 48 4. All communications cabling that has become abandoned as part of new renovation projects, previous
- 49 renovation projects, or temporary communication cables used during the construction process shall be
- 50 completely removed.
- 51 5. Refer to detailed manufacturer's guidelines for deployment of category 6 cable. Certain restrictions
- 52 apply, and specific techniques are recommended.
- 53 6. All cabling shall be installed in accordance with manufacturers' written bend radius and pulling tensions.
- 54 General industry guidelines recommend the following bend radius and pulling tensions:
- 55 a. Tensile loading on a single 4-pair copper UTP cable shall not exceed 25 lbf.
- 56 7. Bend radius of a single 4-pair copper UTP cable shall not exceed 4 times the diameter of the cable.
- 57 8. Bend radius of multi-pair copper UTP and optical fiber cable shall not exceed 10 times the diameter of
- 58 the cable.

- 1 9. All conduits and conduit sleeves shall have bushings or grommets shall be installed prior to the
- 2 installation of communications cables to avoid damage and abrasions to cable sheathing and insulation.
- 3 If bushings have are installed by the electrical Contractor, the communications cabling contract shall
- 4 furnish and install bushings prior to pulling communications cabling.
- 5 10. Horizontal cable length for 4-pair copper UTP cables shall not exceed 295 feet. Prior to bidding and
- 6 installation, the contactor shall review the drawings and verify no cable run exceeds 295 feet and notify
- 7 the communications designer of cable runs that may exceed 295 feet.
- 8 11. Splices are not permitted in any voice or data cable unless other specified or shown on drawings.
- 9 12. Avoid placing copper cables near sources of extreme heat (i.e. boilers, radiators, heat coils).
- 10 13. Maintain cable twists for all UTP cables. For terminations cable sheathing shall be stripping back no more
- 11 than ½" back from termination point for all Category 6 cables.
- 12 14. All cables shall be supported by cable tray, cable runway, or J-hooks. When large quantities of cables
- 13 leave trays or runways, cables shall be supported by drop-outs or cable support hardware manufactured
- 14 specifically for the purpose of supporting cables. J-hooks shall be installed a minimum of every 5 feet and
- 15 cabling shall maintain minimal deflection and strain (less than 12" deflection). Cables shall not be
- 16 supported from ceiling grid wires. Cables shall not run above iron joists.
- 17 15. All cables shall be separated and bundled into like groups.
- 18 16. Service loops shall be provided at both ends of installed horizontal and backbone cabling. A 12" service
- 19 loop shall be installed in the ceiling space near workstation outlets (excessive cable shall not be coiled in
- 20 outlet boxes). A 10' service loop shall be provided in communication rooms and shall be installed to allow
- 21 for future equipment rack/cabinet relocations without the need to re-terminate patch panels; the 10'
- 22 service loop shall be neatly bundled and secured in ceiling space with large D-rings or place in cable trays.
- 23 Cable slack and service coils shall be stored properly above the ceiling or under the access floor. A
- 24 "figure-eight" service loop is recommended for category 6 cabling to reduce EMI coupling. Loose,
- 25 random bundling is recommended.
- 26 17. Any cabling installing in equipment rooms shall be neatly placed in cabling trays, cabling runways, or
- 27 horizontal and vertical rack/cabinet cable managers.
- 28 18. Velcro straps shall be utilized in the TR and inside TC enclosures for all cable bundling. Tie wraps shall be
- 29 prohibited in the telecommunication rooms.
- 30 19. Separation: Maintain the following distances between cables, other system cables and other building
- 31 systems:
- 32 a. One (1) foot from Fluorescent Light.
- 33 b. One (1) foot from power cable in parallel.
- 34 c. One (1) foot from electrical conduits, other systems cables or other electrical equipment.
- 35 d. Four (4) feet from motors or transformers
- 36 e. Three (3) feet from hot water piping or other mechanical equipment.
- 37 f. Ten (10) Feet from Bus Conductors or high-current branch circuits.
- 38 20. All low voltage cables shall be run parallel or at right angles to building structural framework. Do not run
- 39 cables diagonally across ceiling space without written authorization by the Architect's Electrical Engineer
- 40 or CITY OF MADISON Representative.
- 41 21. Communications cabling that must cross power cables or conduit shall cross at a 90-degree angle, and
- 42 shall not make physical contact.
- 43 22. Fire seal around all cables running through rated floors and walls. Firestop all cables and pathways that
- 44 penetrate fire-rated barriers using approved methods and according to local codes.
- 45 23. Leave spare pull string with every outlet installed.
- 46 24. Do not install cable in wet areas, or in proximity to hot water pipes or boilers.
- 47 25. Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling
- 48 operations. Installed cable jackets shall have no abrasions with exposed conductor insulation or bare
- 49 copper "shiners". The installer is responsible to replace damaged cables.
- 50 26. Backbone cables shall be installed and bundled separately from horizontal distribution cables. Backbone
- 51 and horizontal cable bundles shall be loose and random.
- 52 27. Backbone cables spanning more than three floors shall be supported at the top of the cable run with a
- 53 wire mesh grip and on alternating floors, unless otherwise specified by local codes or manufacturer's
- 54 guidelines.
- 55 28. Vertical runs of backbone cables entering each TR shall be securely fastened along a properly prepared
- 56 wall in the TR on each floor. Use of cable ladder is recommended.
- 57 C. Communications Infrastructure

- 1 1. Maximum cable lengths to be 295 feet (90 m) including service loop. Provide all necessary installation
- 2 materials, tools and equipment.
- 3 2. Support and secure cables at patch panels using rear cable management bracket, spools or management
- 4 device.
- 5 3. Cross-connects shall be completed as per construction schedule.
- 6 D. Optical Fiber Cable:
- 7 1. Inner-ducts of the proper rating will be run between each closet.
- 8 2. Cables for direct burial, aerial, or other outside applications shall be designed specifically for the intended
- 9 purpose.
- 10 3. All optical fiber installations shall be installed using open cabling methods. Limit cable-bending radius to
- 11 20 times the cable diameter during installation, and 10 times the diameter after installation. Provide all
- 12 required tools, materials, consumables, and equipment necessary for field mounting of LC connectors.
- 13 4. Do not exceed the maximum pull tension specified by the cable manufacturer. Use appropriate lubricants
- 14 as required to reduce pulling friction. Avoid kinking and twisting of cables during installation.
- 15 5. Label each end of each cable as to source and destination. Terminate optical fibers in consistent,
- 16 consecutive manner at each end. Place all material in inner-duct between Label Optical Fiber raceway
- 17 cable with yellow "Caution - Optical Fiber Cable" tags every 10 feet. Leave 10 feet of slack at each fiber
- 18 termination point. Neatly coil slack optical fiber cable on top of rack above optical fiber patch panel
- 19 enclosure at each rack location.
- 20 6. Optical fiber cable terminations shall utilize enclosures and components in quantities consistent with the
- 21 required fiber counts at each end of each segment.
- 22 7. During optical fiber connector termination, visually inspect all terminations with a 200 or 400-power
- 23 microscope.
- 24 8. Follow all of the connector manufacturer's recommendations.
- 25 9. Unacceptable flaws in the terminations will include, but not limited to, scratches, full or partial cracks,
- 26 bubbles, pits, epoxy residual, dirt, dust, oil, moisture, grinding and sanding debris. The acceptable
- 27 termination will show a connector tip that is free of all imperfections in 100% of the core and 80% of the
- 28 cladding. All unacceptable connectors shall be inspected after rework.
- 29 10. During installation of optical fiber cable do not allow pulling tension to exceed cable manufacturer's
- 30 specification for the cable being installed. Only the strength member of the cable shall be subjected to
- 31 the pulling tension.
- 32 11. Clean all optical fiber connector tips prior to inserting them into matting receptacles or bulkheads. Install
- 33 all dust covers.
- 34 12. Using approved methods, pull cable into conduit, or place into raceway or cable tray as specified. A pull
- 35 cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- 36 13. Where cables are installed in air return plenum, riser rated cable shall be installed in metallic conduit.
- 37 14. Backbone and horizontal cables shall be installed and bundled separately in any pathway.
- 38 15. Cables above ceilings or below access floors shall be installed in cable tray or open-top cable hangers.
- 39 16. Cable slack and service coils shall be stored properly above the ceiling or under the access floor. Pathway
- 40 fill ratio in conduit, tray, raceway, etc. shall not exceed 40% of pathway cross-sectional area.
- 41 17. A service coil of at least 1 meter is recommended within workstation outlets, and at least 2 meters is
- 42 recommended for telecommunications enclosures. Main trunk and OSP cables shall also have a large
- 43 diameter service coil in the specified location.
- 44 18. Recommended maximum spacing of cable supports above the ceiling is 60 in.
- 45 19. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run
- 46 with a wire mesh grip and on alternating floors or as required by local codes.
- 47 20. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other approved structure
- 48 to support the weight of the cable. Do not exceed maximum cable vertical rise limits.
- 49 21. Cables that are damaged during installation shall be replaced by the contractor.
- 50 E. RACKS AND ENCLOSURES:
- 51 1. Freestanding equipment racks and enclosures shall be protected free of all dust, debris and other
- 52 environmental elements during construction until substantial completion walk-through.
- 53 2. Each rack, enclosure shall have a dedicated #6 AWG ground wire to a grounding buss bar or building
- 54 ground as defined by NEC.
- 55 3. Secure racks and enclosures to floor using rack installation kit.
- 56 F. CATEGORY 6 JACKS

- 1 1. Refer to specific manufacturer's guidelines for termination of jacks and dressing category 6 cables inside
2 wall outlets and surface housings. Due to the larger size of category 6 cable, service coils in outlet boxes
3 and surface housings are not recommended.
- 4 2. Terminate jacks according to manufacturer's instructions.
- 5 3. All jack will be wired utilizing T568B.
- 6 4. To assure 10GBase-T performance, maintain wiring pair twists as close as possible to the point of
7 termination. Also minimize the length of exposed pairs from the jacket to the IDC termination point
8 during installation.
- 9 5. The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).
- 10 6. Jacks shall be properly mounted in plates, frames, or housings with dust caps fully installed over IDC
11 contacts.
- 12 7. Horizontal cables extending from mounted jacks shall maintain a minimum bend radius of at least 4 times
13 the cable diameter, unless space is restricted. Note: Refer to specific manufacturer's recommendations
14 for restricted cable bend radius.
- 15 8. Cable terminations shall minimize tensile or bending strain on IDC contacts after assembly of faceplate or
16 housing to the wall outlet.
- 17 G. CATEGORY 6 PATCH PANELS
- 18 1. Properly mount patch panels into the designated rack, cabinet, or bracket locations with the #12-24
19 screws provided.
- 20 2. Terminate cables behind the patch panel according to manufacturer's instructions.
- 21 3. To assure performance, maintain wiring pair twists as close as possible to the point of termination. Also
22 minimize the length of exposed pairs from the jacket to the ICD termination point during installation.
- 23 4. The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm), and shall be
24 kept to a minimum.
- 25 5. Each terminated and dressed cable shall be maintained perpendicular to the rear cover using the
26 recommended cable management hardware.
- 27 6. Horizontal or backbone cables extending from the rear panel terminations shall maintain a minimum
28 bend radius of at least 4 times the cable diameter.
- 29 7. Cable terminations shall have minimal tensile or bending strain on panel IDC contacts in each installed
30 location.
- 31 8. Panels shall be properly labeled on the front and back with the cable number and port connections for
32 each port.
- 33 H. Harsh Environment Housing and Connectivity
- 34 1. Mount connector housing from front of device but Install Gasket or optional Protective Cap before
35 mounting connector housing into device.
- 36 2. Secure connector housing to device using supplied plastic nut. Tighten nut with 6-7 inch/pounds of
37 torque.
- 38 3. Ensure that mounting surface is clean and free of debris.
- 39 4. Installing the jack into the mounted connector housing.
- 40 5. Install the terminated jack into the mounted connector housing by tilting the jack and securing the fixed
41 latch in the connector opening. Rotate the jack, securing the spring latch.
- 42 6. Clean and remove any obstructions from the surface that the wall plate assembly will be installed against.
- 43 7. Place washers provided with HI Impact series plates onto screws. Align rubber gasket on back side of
44 plate prior to installing to box/wall by placing screws through plate and rubber gasket.
- 45 8. Secure the wall plate assembly to box/wall by tightening screws with 5 inch/pounds of torque.
- 46 9. Attach patch cords and field term plug assemblies (sold separately) to the mounted connector.
- 47 I. OPTICAL FIBER CONNECTORS, HORIZONTAL AND BACKBONE
- 48 1. Installed fiber connectors shall have proper cable support, routing and strain relief.
- 49 2. Installed connectors shall be inspected 100% for polish quality, and contamination.
- 50 3. Fusion splices for pigtail connections shall be protected in a suitable enclosure.
- 51 J. GROUNDING and BONDING SYSTEMS: Basic Guidelines
- 52 1. Telecommunications grounding and bonding system shall be installed in accordance with NEC
53 requirements, and per the guidelines of ANSI J-STD-607-A.
- 54 2. The Telecommunications Main Grounding Buss Bar (TMGB) shall be bonded to the building main
55 electrical service ground (Grounding Electrode Conductor or GEC), using approved lugs or exothermic
56 weld methods. Bonding to the GEC or TMGB with sheet metal screws is prohibited.

3. The Telecommunications Bonding Backbone shall be a minimum 6 AWG copper wire conductor. A Telecommunications Grounding Buss Bar (TGB) shall be installed in the TR on each floor, and shall be bonded to the TBB. All metal racks, cabinets, pathway and enclosures shall be bonded to the TGB.
4. Telecommunications equipment shall be grounded according to manufacturer's instructions and in accordance with applicable codes.
5. All metallic pathways, including conduit, raceway ladder or cable trays shall be electrically continuous and shall be bonded to ground on each end.
6. OSP cable entering the building or backbone cables having metal sheaths shall have isolation protection. Isolation protectors shall be bonded to the TMGB.

3.5. LABELING

A. General:

1. **All labels shall be permanent, machine generated labels produced by a labeling machine.** Labels shall be a permanent polyester material clear in color with label lettering black in color. No hand written labels will be accepted.
2. Labeling information will be reviewed at Pre-Install Meeting, and the Owner shall approve the labeling scheme prior to the installation of any cabling.
3. Surfaces shall be cleaned before attaching labels. All labels shall be attached firmly and vertically plumb on equipment, faceplates, patch panels termination blocks, etc.
4. All labeling of cables, equipment, and components shall be included in as-built documentation, floor plan drawings, and schematic designs.

B. Cabling

1. All structured cables (horizontal and backbone) shall be labeled at both ends within 6" of cable termination point. Where voice backbone cables extend behind termination blocks, cable labels shall be placed at a location on the cable where the labels are visible from the front of the termination blocks.
2. Labels shall have an adhesive backing and shall wrap completely around the circumference of the cable jacket. Label and lettering sizes shall be of appropriate size in regard to cable diameter.

C. Equipment Racks, Termination Hardware, and Faceplates

1. LABELING SCHEME TO BE SPECIFIED BY OWNER.

3.6. TESTING

A. Category 6 and 6A Cable Testing

1. Permanent Link Testing shall be completed on all horizontal (station) cables. The Contractor will be responsible to supply a Channel warranty, but CITY OF MADISON is requiring that the contractor supply all manufacturer patch cords per the contract.
2. Category 6 and 6A cabling systems shall be tested as an installed horizontal permanent link configuration. Jacks and faceplates shall be assembled complete and properly mounted into outlet boxes. Panels shall be terminated complete and fully dressed in proper cable management.
3. All wiring shall be certified to meet or exceed the specifications as set forth in TIA-568C for Category 6 requirements for permanent link. All test will be performed to 250MHz.
4. Field Testing shall include the following parameters for each pair of each cable installed:
 - a. Name of the person performing the test.
 - b. Test equipment manufacturer and model number.
 - c. Cable I.D. The test sheets will be in numerical order by cable ID.
 - d. Date of test.
 - e. Wire map (pin to pin connectivity and polarity check)
 - f. Length (in feet)
 - g. Insertion Loss.
 - h. Near End Crosstalk (NEXT).
 - i. Power Sum Near End Crosstalk (PSNEXT).
 - k. Equal-Level Far End Crosstalk (ELFEXT).
 - l. Power Sum Equal-Level Far End Crosstalk (PSELFEXT).
 - m. Return Loss.
 - n. Delay Skew.
 - o. Attenuation to Crosstalk ratio (ACR).
5. A "PASS" indication shall be obtained for each link, using at minimum a level III tester that complies with TIA/EIA-568-B.2 field test requirements.

- 1 6. Record test results for each cable and turn over to the General Contractor Upon completion of the job.
2 Correct malfunctions when detected, and re-test to demonstrate compliance. Note: Test equipment
3 shall be a Type III cable Tester.
- 4 B. Optical Fiber Testing:
- 5 1. Test procedures shall be as described by the TIA/EIA-568-B: Commercial Building Telecommunications
6 Cabling Standard, Parts 2 and 3 and TIA/EIA-526-14-A-1998 - Optical Power Loss Measurements of
7 Installed Multimode Fiber Cable Plant-OFSTP-14A
- 8 2. Preinstallation Testing:
- 9 a. Test each conductor of every optical fiber cable on the reel with a light source and a power meter.
10 b. Obtain the cable manufacturer power meter test results for each reel used on the project. Using
11 the attached Optical Fiber Test Form record the readings and the manufacturer's reel number.
12 Prior to completion of project, turn over the completed optical fiber test form, optical fiber cable
13 reel ID tags and optical fiber cable manufacturer's test results.
- 14 3. Acceptance Testing:
- 15 a. Each terminated fiber strand in the horizontal or backbone infrastructure shall be tested
16 individually as a permanent link. A fiber permanent link is defined as a length of individual fiber
17 strand with a connector terminated on each end.
- 18 b. Testing for multimode shall be at 850 and 1300 nanometers. Total link insertion loss (dB) shall be
19 within the specified link loss budget.
- 20 c. Tier 1 testing for each installed singlemode link shall be performed as an optical power insertion
21 loss measurement, as defined by ANSI/TIA/EIA-526-7. Testing for singlemode shall be at 1310 and
22 1550 nanometers. Total link insertion loss (dB) shall be within the specified link loss budget.
- 23 d. Tier 2 testing, if required for each installed singlemode or multimode link, shall be performed as
24 an OTDR measurement, as defined in TIA-TSB-140. We require Tier 2 testing on all fibers installed
25 in the facility for future troubleshooting.
- 26 e. Multimode optical fiber attenuation shall be tested on all individual fibers of each cable segment
27 using an LED light source and power meter to determine the actual loss. These tests shall be
28 performed at the 850nm and 1300nm windows in both directions. Test set up and performance
29 shall be in accordance with ANSI/TIA/EIA-526-14A, Method B.
- 30 f. A reference power measurement shall be obtained by connecting one end of test jumper 1 to the
31 light source and the other end to the power meter. After recording the reference power
32 measurement, test jumper 1 shall be disconnected from the power meter without disturbing the
33 light source and attached to the cable plant. The power meter shall be moved to the far end of
34 the cable plant and attached to the cable plant with test 2.
- 35 g. Readings must not be higher than the "Optimal Attenuation Loss." The OAL will be calculated
36 using the manufacturer's factory certified test results, (db/km) converted to the actual installed
37 lengths plus the manufacturer's best published attenuation losses for the connector and/or splice
38 installed on this project. (0.30+/-0.30 for Connectors and 0.10 for splices). The construction
39 manager shall use the OAL for comparison with the end to end power loss test results prior to
40 acceptance.
- 41 h. Test Results: Must be completed and turned over to the General Contractor prior to active
42 equipment installation. Specific due dates for optical fiber will be established at pre-install
43 meeting.
- 44
- 45

END OF SECTION

SECTION 27 21 33
WIRELESS ACCESS POINTS (WAP)

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16 **PART 1 – GENERAL**

17
18 **1.1. SCOPE**

- 19 A. The work under this section is for the installation of OWNER PROVIDED, CONTRACTOR INSTALLED Wireless
20 Access Points (WAP).
21 B. The WAPs shall be installed by the contractor providing and installing the Communications Cable and Equipment.
22 All contractor qualifications and certifications for that section shall apply to this section.
23

24 **1.2. RELATED SPECIFICATIONS**

- 25 A. The Contractor shall be responsible for reviewing all other specifications for requirements associated with the
26 complete installation of WAP's. This includes but is not limited to the following:
27 1. 01 31 23 Project Management Web Site
28 2. 27 00 05 Communications Cable and Equipment
29

30 **1.3. SUBMITTALS**

- 31 A. Contractor licenses and qualifications are required as part of the complete Division 27 submittal package
32 as indicated under Specification 27 00 05.
33 B. No submittals are required for the owner provided WAP.
34 C. Submittals are required for installation/hanger equipment, connectors, and any other required
35 equipment/material required for a complete WAP installation.
36

37 **PART 2 - PRODUCTS**

38
39 **2.1. WIRELESS ACCESS POINT (WAP) DEVICES**

- 40 A. The City of Madison Information Technology Department (CoM-IT) will be providing the WAP devices for this project.
41 B. The WAP device being used will be as manufactured by the Cisco and shall be used for all types of ceiling mounted
42 installations. (suspended, gyp board, open truss, etc.).
43

44 **PART 3 - EXECUTION**

45
46 **3.1. OWNER RESPONSIBILITIES**

- 47 A. The CoM-IT shall be responsible for ordering, making payment and configuring all WAP devices.
48 B. The CoM-IT shall configure and test each WAP to CoM-IT specifications prior to providing the WAP to the
49 contractor for installation.
50 C. The CoM-IT shall number each WAP and provide the contractor with a location map indicating where each WAP
51 shall be installed.
52 D. The CoM-IT shall test each WAP after installation to verify configuration and signaling is correct prior to accepting
53 the final installation of the WAP system.
54

55 **3.2. CONTRACTORS RESPONSIBILITIES**

- 56 A. The Contractor shall be solely responsible for coordinating with CoM-IT the scheduling and receipt of all WAP
57 devices with the installation schedule.

- 1 B. The Contractor shall inspect all WAP devices upon receipt for damage. CoM-IT shall be notified immediately of
- 2 any damage.
- 3 C. The Contractor shall provide all mounting hardware, blocking, and other items required for a complete
- 4 installation that meets the manufacturer's installation requirements.
- 5 D. The Contractor shall install all WAP devices per plans and specifications including cable connections.
- 6 E. The Contractor shall be responsible to pick up WAP devices from City IT and delivery to the jobsite.
- 7

8 **3.3. FINAL TESTING**

- 9 A. Contractor shall provide final testing of all WAP devices after installation is complete.
- 10 B. In the event any WAP device is not operating properly the contractor shall trouble shoot the Installation and work with
- 11 the CoM-IT to determine if re-configuration of the device will be required.
- 12 C. The CoM-IT shall be responsible for reconfiguring WAP's as needed after installation is complete. The contractor
- 13 shall be responsible for verifying connections, cabling and connectivity of the installation is correct.
- 14

15 **3.4. WARRANTY**

- 16 A. The CoM-IT will be responsible for registering any warranty information associated with the purchase and ownership of
- 17 all the WAP devices.
- 18 B. The Contractor shall warrant the installation of the WAP device for one (1) year per the terms of this contract.
- 19

20
21

END OF SECTION

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PROFESSIONAL AUDIO/VIDEO SYSTEM

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PART 1 – GENERAL

1.1. SCOPE

- A. This specification is for informational purposes only. The scope of work outlined in this specification shall be provided as part of the project, but detailed on AV sheets.

1.2. SECTION INCLUDES

- A. System Components
- B. Audio Connectors

- C. Audio Cabling
- D. Video Connectors
- E. Digital Video Cabling
- F. Transmission Connectors
- G. Transmission Cabling
- H. Control Cabling
- I. Horizontal Copper and Fiber Cabling and Connectors

1.3. RELATED WORK

- A. Section 270500 - Basic Communications Requirements

1.4. QUALITY ASSURANCE

- A. Manufacturer: The manufacturer of equipment shall have a complete service organization for all products in the manufacturer's line.
- B. Integrator/Dealer: The Contractor shall be a factory-authorized and certified integrator/dealer specializing in each selected manufacturer's products, with demonstrated prior experience with the selected manufacturer's systems, installation and programming.
- C. The following qualifications have been endorsed by the AudioVisual and Integrated Experience Association (AVIXA) which is formerly known as InfoComm International.
 - 1. The Contractor shall have the services of a Certified Technology Specialist on staff and supervising the project. This service shall not be subcontracted. In addition to supervising the project, the CTS-I shall perform the the following tasks on the project:
 - a. Review submittals and provide a letter stating the submittals are in compliance with the contract documents.
 - b. Provide written and dated confirmation of an observation of the contractor's installation activities no less than every 2 weeks during the construction period.
 - c. Provide a final written and dated confirmation of a final construction review prior to testing.
 - d. Review final testing and calibration of the systems and provide a letter with the documented results or transmittal of the results stating the test results and calibration compliance with the contract documents.
 - D. A certification of CCENT or CCNA from CISCO. CCNP certification satisfies either of these requirements.
 - E. The Contractor shall have in-house services of a Microsoft Certified Systems Engineer (MCSE) or equivalent technician for the purposes of server deployment, software configuration, and system integration for those systems that reside in a Microsoft environment.
 - F. Control System Dealer: The media control system shall be provided, terminated, installed, and programmed by a factory-authorized and certified dealer and integrator in good standing with the manufacturer. The dealer shall have direct purchasing and support authority. These services shall not be subcontracted.
 - G. Control System Programmer: The media control system shall be programmed by a factory-trained and certified programmer.
 - 1. The Contractor shall have all certifications required by the manufacturer(s) for the installed system components on staff for the appropriate duties and responsibilities required by the manufacturer.
 - a. The control system programmer shall have all refresher courses completed for the latest features of the control platform prior to bidding the project to ensure that the Contractor is up to date with the latest software features.
 - b. The control system programmer shall have achieved the highest programmer level obtainable by the control manufacturer (e.g., master programmer).
 - 2. The Contractor shall be fluent in the control systems preferred language (e.g., Python, C#, Java, JavaScript, SQL, PHP, etc.) required to complete the programming requirements of the AV system.
 - H. Audio System Programmer: All digital sound processing equipment (DSP) used on the project shall be setup, programmed and calibrated by a factory-trained and certified technician. All audio signals shall be delivered via Dante. Programmer shall provide the Owner with an auto-mixed program output as well as pre-fade signals from each source/input.
 - 1. The audio system programmer shall have the following complementary certifications:
 - a. Associated manufacturer certifications
 - b. Dante Level III
 - I. Video System Programmer: All video distribution and processing used on the project shall be setup, programmed and calibrated by a factory-trained and certified technician.

- J. The Contractor shall have acquired and maintained all certifications for a minimum of one (1) month prior to the posted bid date of this project.
- K. Servicing Contractor: The installer must be factory certified to provide service on the installed manufacturer's equipment and must have local service representatives within a 100 mile radius of the project site.

1.5. REFERENCES

- A. ADA - Americans with Disabilities Act
- B. ADAAG - Americans with Disability Accessibility Guidelines
- C. ANSI - American National Standards Institute
- D. AVIXA - Audiovisual and Integrated Experience Association
- E. ANSI/InfoComm A102.01:2017 - Audio Coverage Uniformity
- F. ANSI/InfoComm 2M-2010 - Standard Guide for Audiovisual Systems Design and Coordination Processes
- G. ANSI/InfoComm F501.01:2015 - Cable Labeling for Audiovisual Systems
- H. ANSI/InfoComm 10:2013 - Audiovisual Systems Performance Verification
- I. ANSI/AVIXA V202.01:2016 - Display Image Size for 2D Content in Audiovisual Systems
- J. ANSI/InfoComm 3M-2011 - Projected Image System Contrast Ratio
- K. IBC - International Building Code
- L. IEC - International Electrotechnical Commission
- M. NFPA 70 - National Electrical Code (NEC)
- N. UL 813 - Commercial Audio Equipment
- O. UL 1419 - Professional Video and Audio Equipment
- P. UL 1480 - Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
- Q. UL 1492 - Audio/Video Products and Accessories

1.6. SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 270500.
- B. General Requirements:
 - 1. Submittals will be submitted in multiple passes over the course of construction. Each pass will be a dedicated single submission for review as outlined in the general submittal requirements outlined in section 270500.
 - 2. Should the Contractor not provide shop drawings in a timely fashion, not complete requirements or extend the time of any resubmittals so as to jeopardize schedules, cause delay, or limit access for field work, the Contractor bears responsibility for impact and delay that may occur. This includes access or lift to overhead positions and associated protection of the work already in place.
- C. First Pass Submittals: To be submitted after the project is awarded but before equipment is submitted, purchased and installed.
 - 1. Contractor(s) resume of qualifications.
 - 2. All certifications shall be current and valid. Any certificate with expired dates will not be accepted.
 - 3. All applicable AudioVisual and Integrated Experience Association (AVIXA) certifications. Qualifications from InfoComm that have not expired shall be accepted.
 - 4. All certifications outlined in the qualifications shall be included in this submittal. Refer to the qualifications section for additional information. Certifications include, but are not limited to:
 - a. All installed manufacturer certifications required by the manufacturer.
 - b. Control system authorized dealer certification.
 - c. Control system certified programmer certification(s).
 - d. Audio system DSP dealer certification.
 - e. Audio system DSP programmer certification.
 - f. Video system dealer certification(s).
 - g. All other applicable dealer, installation and programming certifications.
 - h. All applicable Microsoft certifications.
 - i. All applicable networking certifications.
 - 5. Audio and video calibration equipment certifications.
 - 6. Audio and video testing and calibration equipment and software procedures and manufacturer- specific equipment calibration certificates.
- D. Second Pass Submittals: To be submitted after all initial submittals have been approved but before equipment is purchased, installed, configured, and programmed. This can be submitted with the first pass submittal but will be required in a separate document.

1. Product Data: Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:
 - a. Compliance with each requirement of these documents.
 - b. All component options and accessories specific to this project.
 - c. Electrical power consumption rating and voltage.
 - d. Wiring requirements.
 - e. Pre-terminated cable distances and requirements identified by each room where required.
 - f. Product manuals are not an acceptable format and will be rejected.
- E. Final Pass Submittals: To be submitted after all initial submittals have been approved but before equipment is purchased, installed, configured, and programmed. These should not be submitted until after the pre-installation meeting outlined in Part 3.
 1. System Drawings: Project-specific system drawings shall be provided as follows:
 - a. Provide a system block diagram noting system components and interconnection between components. The interconnection of components shall clearly indicate all wiring required in the system. When multiple pieces of equipment are required in the exact same configuration the diagram may show one device and refer to the others as "typical" of the device shown.
 - b. Submittals shall contain shop drawings indicating physical plan locations and placement of installed devices and accessories with associated scope or field conditions for review and coordination. Provide mounting details, suspensions, and rough-in notes with trade demarcations.
 - 1) Identify any non-standard back boxes or mounting assembly required by product or specifications and elaborate contractor means and methods for mounting.
 - 2) Provide rack drawing(s) showing the mounting of equipment in each rack or cabinet on the project.
 - 3) All display mounts shall be coordinated with the Architect to verify the exact vertical and horizontal positioning of the display. Coordinate in-wall stud locations for installation of recessed display mounts to install in the exact location as coordinated with the architectural drawings.
 - 4) Projector mounts shall be coordinated with other utilities on the ceiling and wall to minimize any potential obstructions for the visual beam of the projector prior to installation of the projector mount.
 - 5) Projector mounts, projector screens, recessed ceiling speakers, in-ceiling microphones, and all other above ceiling devices shall be coordinated with other trades in the field (e.g., mechanical ductwork, lights, diffusers, etc.) to minimize changes that will impact the performance of the system design.
 - c. Submit wiring and cable path requirements, including field wiring, path verification, signal separation, and outside diameter of cables for conduit sizing and verification that can be used for field installation and electrical coordination.
 - d. Reproduction of contract documents is not acceptable for submittals. Wire CAD type drawings and cable tag lists or schedules, or typical manufacturer's abbreviated single line alone, are not complete.
 2. The Contractor shall submit graphic or emulated representations of the control system touch panels for each unique space and layout prior to purchase, installation and programming for review and comment by the Architect/Engineer and Owner. These shall show and describe the intended programming/macro control features and functions of each button/icon for all pages.
 3. The Contractor shall submit graphic or emulated representations of the control system keypads for each unique space and layout prior to purchase, installation and programming for review and comment by the Architect/Engineer and Owner. These shall show and describe the intended programming/macro control features and functions of each button/knob.
 4. The Contractor shall submit the actual DSP audio processor files or single line audio path file diagram prior to installation for review and comment by the Architect/Engineer. Provide preliminary settings with processor blocks identified and note resources allocated.
 5. The Contractor shall submit the number of IP addresses, VLANs, and subnetworks that will be required from the Owner's Information Systems Department.
 6. Submit meeting agenda for planning/programming meetings as required in Part 3 of this specification.
 7. Submit detailed description of Owner training to be conducted at project end, including specific training times and typical attendees expected.
 8. Provide rack drawing(s) showing the mounting of equipment in each rack or cabinet on the project. Rack drawings should include the following:

- a. Equipment placement including mounting on the front or rear of the rack.
 - b. Spacing separation as required by equipment for adequate airflow and heat dissipation.
 - c. Signal separation based on AVIXA standards as required by the design.
 - d. Heating/cooling load requirements for submitted equipment to verify the heating/cooling load of the rack. This shall include Owner-provided equipment coordinated with the Owner.
 - e. Power requirements for each rack including plug type and loads based on the final approved products.
- F. Discontinued Products and New Model Releases:
- 1. For each product, the Contractor shall submit (in addition to the specified product) a product cut sheet if the specified product has been replaced, improved upon, phased out or otherwise upgraded at the time of shop drawing submittal.
 - a. The intent of this requirement is for the Contractor to submit only direct replacements for the specified products. A direct replacement shall be defined as a product of newer release that has equal or greater capabilities, which is available for not more than a 10% premium over the specified product's bid unit cost. The Contractor shall submit a letter from the manufacturer with a direct replacement that includes both model numbers to clarify the replacement.
 - b. It is not the intent of this requirement for the Contractor to submit new products or other product options that significantly differ in capability and/or cost from the specified product.
- G. Coordination Drawings:
- 1. Include all ceiling-mounted devices in composite electronic coordination files. Refer to Section 270500 for coordination drawing requirements.

1.7. SYSTEM DESCRIPTION

- A. This specification section describes the furnishing, installation, commissioning and programming of audio/video components and systems.
- B. Performance Statement: This specification section and the accompanying Contract Documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made and every feature and function that must be programmed and configured. Based on the equipment constraints described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.
- C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment and other miscellaneous equipment required for proper system installation and operation shall be provided by the Contractor.
- D. This document describes the major programming features and functions of the system. All additional programming, configuration and integration required for proper system installation and operation shall be provided by the contractor.
- E. When a specific manufacturer is not provided in this document for minor pieces of equipment, the Contractor shall provide only those materials considered to be of the same industry commercial and professional quality level as the major equipment manufacturers.

1.8. LICENSING REQUIREMENTS

- A. All user licenses required for system operation shall be included in the Contractor's bid. User licenses shall include, but not be limited to, server and workstation software and any other licensing that is required by the manufacturer for operation of any system component.
 - 1. Licenses shall be provided on a one-to-one basis. One license shall be provided for each server, workstation, and device requiring a license. In the event the manufacturer requires the purchase of a block of licenses, the minimum standard licensing package to support all devices shall be provided.

1.9. INTELLECTUAL PROPERTY OWNERSHIP

- A. All supporting documentation, programming, uncompiled source code, graphic files, DSP code and diagrams, written and electronic files, including all latest versions of the documentation and software necessary to edit and adapt the system(s), shall be provided to and owned by the City of Madison for all spaces and all systems. The integrator and/or programmer shall also maintain a current copy to be provided at the Owner's request.
 - 1. Vendor may request source code from existing City of Madison systems.

2. The City of Madison shall have the right to modify the intellectual property directly, or to have the intellectual property modified by any party of the Owner's choosing.

1.10. PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 270500.
- B. Provide all applicable certifications.
- C. Provide statement that system checkout test, as outlined in the shop drawing submittal, is complete and satisfactory.
- D. Provide schedules documenting all terminal block wiring, including cable numbers.
- E. Warranty: Submit written warranty and complete all Owner registration forms.
- F. Complete all operation and maintenance manuals as described below.
- G. The Contractor shall include all factory-provided test results for equipment installed on the project.
- H. The Contractor shall include all test results from system demonstration and performance testing specified in This document.
- I. Record Drawings shall minimally include:
 1. All revisions to, or deviations from the original drawings, as well as final dimensions, cable routes, connector panel drawings, cable numbering charts, and control system programming documentation. A complete as-installed equipment list, listed by room, and with manufacturers' names, model numbers, serial numbers, and quantities of each item.
 2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and programming code.
 3. Complete equipment rack layouts showing locations of all rack-mounted equipment items.
 4. Additional information, diagrams or explanations as designated under respective equipment or systems specification section,
- J. Within each equipment room, the appropriate floor plan for which that equipment room serves shall be laminated and mounted for use by the Owner. Functional drawings shall be posted at each AV closet or included at every AV rack within a room.
- K. Upon completion and final acceptance of the project, the Contractor shall provide the Owner a copy of the programming code for any and all AV systems and devices programmed by the Contractor.
 1. For any subsequent modifications to the programming code, an updated copy of the code shall be provided to the Owner.

1.11. OPERATION AND MAINTENANCE DATA

- A. Submit documents under the provisions of Section 270500.
- B. Manuals: Final copies of the manuals shall be delivered after completing the installation. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the Contractor responsible for the installation and maintenance of the system and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation shall include all modifications made during installation, checkout, and acceptance. Manuals shall be submitted in electronic format. The manuals shall consist of the following:
 1. Functional Design Manual: The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included.
 2. Hardware Manual: The manual shall describe all equipment furnished including:
 - a. General description and specifications.
 - b. Installation and checkout procedures.
 - c. Equipment layout and electrical schematics to the component level
 - d. System layout drawings and schematics.
 - e. Alignment and calibration procedures.
 - f. Manufacturers repair parts list indicating sources of supply.
 3. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - a. Definition of terms and functions.
 - b. System use and application software.
 - c. Initializations, startup, and shutdown.
 - d. Reports generation.
 - e. Details on forms customization and field parameters.
 4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the

- operation of the system including:
 - a. Computers and peripherals.
 - b. System startup and shutdown procedures.
 - c. Use of system, command, and applications software.
 - d. Recovery and restart procedures.
 - e. Use of report generator and generation of reports.
 - f. Data entry.
 - g. Operator commands.
 - h. Alarm messages and reprinting formats.
 - i. System permissions functions and requirements.
- 5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
- C. Audio Calibration Data: Provide documentation on all EQ settings, crossover points, limiter settings, gate settings and all other applicable settings.
- D. Intellectual Property Ownership: Provide all uncompiled source code and DSP programming for all systems and spaces as described in Part 3 of this Specification Section. The City shall own the uncompiled source code.

1.12. WARRANTY

- A. Unless otherwise noted, provide warranty for one (1) year after Date of Substantial Completion for all materials and labor.
- B. Onsite Work During Warranty Period: This work shall be included in the Contractor's bid and performed during regular working hours, Monday through Friday.
 - 1. Inspections: The Contractor shall perform two (2) minor inspections at even intervals (or more often if required by the manufacturer), and two (2) major inspections offset equally between the minor inspections.
 - 2. Minor Inspections: These inspections shall include:
 - a. Visual checks and operational tests of all equipment, field hardware, and electrical and mechanical controls.
 - b. Mechanical adjustments if required on any mechanical or electromechanical devices.
 - 3. Major Inspections: These inspections shall include all work described under paragraph Minor Inspections and the following work:
 - a. Clean all equipment, including filters, interior and exterior surfaces.
 - b. Perform diagnostics on all equipment.
 - c. Check, test, and calibrate (if required) any sensors or other equipment that contain settings.
 - d. Check zoom and focus of all projectors.
 - e. Run all system software diagnostics and correct all diagnosed problems.
- C. Operation: Upon the performance of any scheduled adjustments or repairs, Contractor shall verify operation of the systems.
- D. Emergency Service: The Owner will initiate service calls when the systems are not functioning properly. Qualified personnel shall be available to provide service within the distance defined within this specification section. The Owner shall be furnished with telephone number(s) where service personnel can be reached 24/7/365. Service personnel shall be at site within 24 hours after receiving a request for service.
- E. Records and Logs: The Contractor shall keep records and logs of each task completed under warranty. The log shall contain all initial settings at substantial completion. Complete logs shall be kept and shall be available for review on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the systems.
- F. Work Requests: The Contractor shall separately record each service call request on a service request form. The form shall include the model and serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing what must be done, the amount and nature of the materials used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within five (5) business days after work is accomplished.
- G. System Modifications: The Contractor shall make any recommendations for system modification in writing to the Owner. No system modifications shall be made without prior approval of the Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation

affected. To the fullest extent possible, the Owner shall be provided with electronic restorable versions of all configurations prior to the modifications being made.

- H. Software: The Contractor shall provide all software and firmware updates during the period of the warranty and verify operation of the system upon installation. These updates shall be accomplished in a timely manner, fully coordinated with system operators, shall include training for the new changes/features, and shall be incorporated into the operations and maintenance manuals, and software documentation.
- I. Refer to the individual product sections for further warranty requirements of individual system components.

1.13. ANNUAL SERVICE CONTRACT

- A. Provide annual cost for extended service and maintenance warranty after the first year for the audio/video systems according to the following terms:
 - 1. The term of the warranty shall begin on the system acceptance date and shall continue for one (1) year. The extended service and maintenance warranty may begin following this first year if accepted by the Owner. The term may be automatically renewed for successive one-year periods unless canceled by the Owner. The service and maintenance agreement shall include the following basic services to the Owner, including all necessary parts, labor and service equipment:
 - a. Repair or replace any equipment item that fails to perform as initially installed, as specified, or as determined per the manufacturer's performance criteria.
 - b. Perform semi-annual preventive maintenance on the equipment. This preventive maintenance shall include, but is not limited to, cleaning, realignment, bulb replacement, filter cleaning and replacement, inspection, re-calibration, and testing of devices. The Owner shall receive a written report of these inspections that identifies the device's status and, if required, a list of all necessary repairs or replacements.
 - c. Provide software and firmware maintenance on the system. Contractor shall install and configure any software and firmware updates that the manufacturer provides at no cost. Any additional software or firmware options, updates, or enhancements purchased by the Owner shall be installed. The Contractor shall not be responsible for the purchase of additional software packages or the maintenance of Owner data.
 - 2. The Contractor shall be compensated for any repairs or maintenance provided as a result of Owner abuse, misuse, intentional damage, accidental damage, or power fluctuations exceeding specified equipment tolerances.
 - 3. System defects or failures shall be corrected within four (4) hours on the same business day if the Owner makes a service request before 11:00 am, or before 12:00 noon the next business day if the Owner makes the request after 11:00 am. If requested by the Owner, the Contractor shall respond or remain at the site after normal business hours, and the Owner shall reimburse the Contractor for the incremental cost difference between premium labor rates and standard labor rates. This reimbursement applies to premium labor rates that do not exceed time-and-one-half rates after normal business hours and double-time rates for Sundays and holidays. The Contractor's services shall be performed in a good and workmanlike manner and remain free from defects for a period of one (1) year.
- B. Provide complete terms and conditions of warranty and service.
- C. The Owner will enter into a contract directly with the vendor. This specification is not a contract between the Owner and the vendor to perform these services.

PART 2 - PRODUCTS

2.1. SYSTEM COMPONENTS

- A. Refer to the project drawings for basis of design system components. Equivalent products shall meet or exceed all requirements defined on the project drawings. The following product information represents the minimum additional requirements for equivalent products:
- B. Audio/Video GUI Control Systems:
 - 1. Contractor shall furnish a programmable software-based audio/video control system. The system shall be field configurable and programmable by the factory and/or a factory-trained programmer.
 - 2. The control system shall be TCP/IP based allowing direct connection of the system processors to a 10/100BaseT compatible Ethernet network.
 - 3. Vendor shall configure and program all Crestron components so that they can be monitored and controlled by Crestron Fusion. Vendor shall provide X-Panels of all touch panels that can be accessed by Crestron Fusion.
- C. Microphone Systems:

1. Wireless Microphones:
 - a. Wireless microphones shall not operate in the 516 to 865 MHz band (channels 38 to 69).
 - b. Features: Dual antenna reception with true diversity reception.
 - c. Microphone systems that are common (shared) by multiple spaces or when the receivers are in a remote area shall include a compatible wireless antenna distribution system by the same manufacturer as the wireless microphone system.
- D. Audio Amplifiers:
 1. Power Amplifier(s), 25, 70.7 and 100 Volt:
 - a. Power: The following calculation shall be used to determine the minimum required output of the amplifier(s):
 - 1) Calculate the total power tap value of each transformer with insertion loss using the following equation:
 - a) Tap wattage $\times 10^{(x\text{dB}/10)}$ where x = the rated insertion loss at 1,000Hz.
 - 2) Calculate the total wattage loss based on cable distance, cable gauge and cable resistance.
 - 3) Add together all the speaker taps' total power values that will be on a single channel of the amplifier. Multiply that total by 1.2, which will allow for a 20% future expansion. Multiply that number by 1.25 to ensure the amplifier never exceeds 75% of its total output. Utilize the final number to determine the minimum amplifier power requirements.
- E. Power Conditioning and Surge Protective Devices:
 1. All equipment shall be plugged in through a power conditioning surge arrestor.
 2. Provide a minimum of 50 dB noise attenuation.
 3. Provide a minimum of 1,500 joules of surge protection.
 4. UL 1449 Standard for Safety for Surge Protective Devices listed to 330 volt clamping voltage.
 5. Refer to the project drawings for additional information.

2.2. AUDIO CONNECTORS AND CABLING

- A. Refer to Section 270500 for cable rating requirements.
- B. Microphone Level Audio Cabling:
 1. For patch cables less than or equal to 25 feet:
 - a. 24 AWG 2-conductor, twisted, stranded (19x36) tinned bare copper.
 - b. Single Layer Shield 100% aluminum foil shield.
 - c. Nominal Capacitance: 30.0 pF/Ft
 - d. Manufacturers:
 - 1) Belden
 - 2) West Penn
 - 3) Liberty
 2. For patch cables greater than or equal to 25 feet:
 - a. 22 AWG 2-conductor, twisted, stranded (16x34) tinned bare copper.
 - b. Dual Layer Shield 85% tin copper braid shield.
 - c. Nominal Capacitance: 18.0 pF/Ft
 - d. Manufacturers:
 - 1) Belden
 - 2) West Penn
 - 3) Liberty
- C. Line Level Audio Cabling:
 1. For patch cables less than or equal to 25 feet:
 - a. 24 AWG 2-conductor, twisted, stranded (7x30) tinned bare copper.
 - b. Single Layer Shield 100% aluminum foil shield.
 - c. Nominal Capacitance for non-plenum cable: 24.0 pF/Ft
 - d. Nominal Capacitance for plenum cable: 35.0 pF/Ft
 - e. Manufacturers:
 - 1) Belden
 - 2) West Penn
 - 3) Liberty
 2. For patch cables greater than or equal to 25 feet:
 - a. 18 AWG 2-conductor, twisted, stranded (16x30) tinned bare copper.

- b. Single Layer Shield 100% aluminum foil shield.
 - c. Manufacturers:
 - 1) Belden
 - 2) West Penn
 - 3) Liberty
 - D. Constant Voltage Speaker Cabling:
 - 1. Class 2, stranded, twisted, 2-conductor, minimum of 16-gauge wire for all 25/70.7/100-volt applications unless noted otherwise.
 - 2. The Contractor shall size cabling as required for distance power and shall provide larger gauge cable as required.
 - 3. Manufacturers:
 - a. Belden
 - b. Liberty
 - c. or preapproved equal
- 2.3. DIGITAL VIDEO CABLING**
- A. All digital video cabling shall be pre-assembled and tested in a factory and not field terminated. The contractor shall field verify the cable distance and provide the proper cable type and length.
 - B. High Definition Multi-Media Interface (HDMI) "High Speed" Cable:
 - 1. For any cable run that exceeds the manufacturer-recommended distances or fails to transmit video or audio due to cable length, the Contractor shall provide and install an HDCP-compliant signal equalizer at the far end (sink).
 - 2. Provide HDMI cabling meeting HDMI 2.0 standards or greater:
 - a. HDCP compliant.
 - 1) Belden
 - 2) Or pre-approved equal
 - C. Display Port Cable:
 - 1. For any cable run that exceeds the manufacturer-recommended distances, the Contractor shall provide and install an HDCP and DPCP compliant signal equalizer at the far end (sink).
 - 2. Supports a maximum digital data rate of 8.64 Gbit/s.
 - 3. Supports HDCP and DPCP.
 - 4. Manufacturers:
 - a. Blue Jeans Cable
 - b. Or pre-approved equal
- 2.4. CONTROL CABLING**
- A. Control:
 - 1. For Bidding Purposes: Two-pair, twisted, shielded, one (1) #18 AWG pair and one (1) #22 AWG pair. Provide with plenum-rated jacket where used in a plenum space without conduit.
 - 2. Size conductors as required for distance and voltage drop.
 - 3. Coordinate exact requirements with selected manufacturer and system prior to submitting bid.
 - B. Other Control Circuits:
 - 1. #20 AWG, stranded, shielded cable, number of conductors as required for the applications. Provide with conduit or non-plenum areas.a.
 - 2. Coordinate exact requirements with selected manufacturer and system prior to submitting bid.
- 2.5. HORIZONTAL COPPER DATA AND FIBER CABLING AND CONNECTORS**
- A. Refer to Section 271500 - Horizontal Cabling Requirements, for telecommunications cabling and connector requirements including fiber optics being utilized for A/V systems.
 - B. All category-rated copper data cabling and fiber optic cabling shall be installed, terminated, tested and certified by the Division 27 Telecommunications contractor certified by the selected manufacturers for the copper and fiber optic cabling plant. The Contractor shall submit all cabling and certifications to the Architect/Engineer for approval in the shop drawings.
 - C. The A/V contractor shall coordinate purchase, installation, testing and certification with the telecommunications contractor for all required category-rated copper data cabling and fiber optic cabling required for A/V system operation prior to bid.

PART 3 - EXECUTION

3.1. EXAMINATION

- A. Verify that surfaces are ready to receive work.

- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.

3.2. PRE-INSTALLATION

- A. A pre-installation meeting shall be held after the project has been awarded but before any submittals or work has been conducted. The purpose of this meeting is to review the drawings and specifications to assist with the construction and installation process that will occur during construction. The meeting will include the Engineer, Architect, Owner, and all relevant installing contractors for this system. The meeting will be chaired by the project manager for the AV contract and will include all relevant topics.
- B. The Contractor shall be responsible for submitting all requested submittals and holding the pre-installation meeting prior to any purchasing, installation, programming, and construction coordination. Any delays or changes to the project as a result of meeting this requirement will be at the Contractor's expense.

3.3. INSTALLATION

- A. Comply with the manufacturer's instructions and recommendations for installation of all products.
- B. Provide all system wiring between all components as directed by the manufacturer or required for proper system operation.
- C. Mount all touch screen and keypad devices where shown on plans in accordance with Americans with Disabilities Act (ADA) requirements for both side reach and front reach.
- D. Cabling Requirements:
 - 1. Non-plenum rated cabling may be used instead of plenum when installed with-in conduit in plenum rated areas.
 - 2. All cabling shall be routed according to function. Cabling shall be grouped and bundled by groups, such as: microphone and line level audio, control, video and speaker. In no case shall cabling from different functional groups be intermixed. No cabling shall be routed parallel to 120 VAC or higher power circuits unless separated by a minimum of 6" and the 120 VAC or higher power is installed in conduit.
 - 3. When cabling is installed in conduit, a separate conduit shall be provided for each cabling functional type.
 - 4. Cable bundles shall be loosely bundled to allow the visual following of individual cables within the bundle and to permit the easy removal and addition of cables as necessary.
 - 5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable zip ties is strictly prohibited in any situation.
 - 6. Cabling shall not be spliced under any circumstances.
 - 7. Each cable shall be appropriately identified (as defined on the record documents) at each end's termination point using pressure sensitive label strips.
 - 8. Audio Cabling:
 - a. All amplified audio cabling shall not be in the same enclosed pathway as any other type of cabling as required by the NEC. Refer to the NEC for definitions and additional requirements.
 - b. The polarity of all cabling shall remain consistent throughout the project, on all equipment. Red conductors shall be used for the positive "+" side, and black used for the negative "-" side.
 - c. Cable shield length shall be equal to the cable's conductor length.
 - d. All shielded cables drain wire SHALL be grounded and continuous throughout the entire length of the system, including splices where speakers are installed.
 - e. Balanced audio connections shall be used whenever the mating equipment allows.
 - f. Do not run unbalanced cables longer than 3m. For interconnecting of unbalanced equipment in lengths longer than 3m, the Contractor shall provide a line driver located at the source.
 - 9. Video Cabling:
 - a. All video cabling, unless otherwise noted, shall be provided with BNC connectors of the two-piece compression type. Twist-on BNC connectors are not permitted.
 - b. Provide BNC 75-ohm terminators where required for all open BNC connectors.
 - c. All coaxial video cables used for S-video, component/RGB and RGBHV shall be the same length to minimize skew.
 - 10. Twisted Pair Cabling for All Applications:
 - a. The Contractor shall ensure that the twists in each cable pair are preserved to within 0.5 inch of the termination. The cable jacket shall be removed only to the extent required to make the termination.
 - b. The Contractor shall ensure that the cable shields are continuous throughout, terminated, and grounded according to the manufacturer's recommendations.

- E. Grounding Requirements:
 - 1. Provide a minimum of #6 AWG conductor from the nearest electrical service ground bus or nearest telecommunications room ground bus bar to the A/V equipment racks and cabinets regardless of location. Size cable as required by the NEC.
 - 2. Cables containing shields shall not have the shields grounded at conduits, boxes, racks, etc. Ground the shield only at the equipment end.
 - 3. Audio cable shields for line-level signals shall be connected to the metal equipment chassis at both ends of the cable.
 - 4. Audio cables connected to transformers shall have the cable shield connected to the transformer shield and transformer case ground.
 - 5. The Contractor shall not connect cable shields together from differing cables.
 - 6. XLR cable shields shall be connected to chassis ground.
 - 7. Signal-grounded balanced shields are not acceptable and shall not be installed. All balanced shields shall be chassis grounded.
- F. Rack and Cabinet Requirements:
 - 1. Ground equipment racks/cabinets as noted within this specification section.
 - 2. Provide one (1) RU of space between adjacent pieces of equipment with top and/or bottom vents, above the topmost piece of equipment, and below the bottommost piece of equipment. Provide a vented cover panel covering each rack space.
 - 3. Terminate all speaker cabling on individual barrier strips for positive "+", negative "-", and shield. The shield barrier strip shall be grounded.
 - 4. Provide a power conditioning surge arrestor in the rack for distribution of AC power from the wall receptacles indicated on the plans.
 - 5. Power sequencing shall be provided in the racks where shown on the drawings. All amplifiers located in the racks shall be sequenced "last on – first off". Power sequencers shall provide power conditioning and surge protection.
- G. Video System Installation Requirements:
 - 1. Video display image shall fill screen area with native aspect ratio.
- H. Audio System Installation Requirements:
 - 1. The Contractor shall perform calculations for the optimal speaker tap settings to reach the desired SPL level and coverage without overloading the amplifier(s).
 - a. At a minimum, the following calculations shall be used:
 - 1) Add together all speaker taps that will be on a single channel of the amplifier. Multiply that total by 1.2, which will allow for a 20% future expansion. Multiply that number by 1.25 to ensure the amplifier never exceeds 75% of its total output. Utilize the final number to determine the minimum amplifier power requirements.
 - 2) For direct coupled systems (low impedance), allow a minimum of 10 dB headroom before any distortion occurs at the amplifier input indicator when beginning gain stage tests are set up. Increase headroom as appropriate for high impact and clarity needs, typically exceeding 12 to 15 dB during continuous operation.
 - 2. Connections of balanced to unbalanced equipment shall only be done through an active converter at the unbalanced side.
 - 3. Connections of unbalanced to balanced equipment shall only be done through an active converter at the unbalanced side.
 - 4. Connections from stereo balanced or unbalanced equipment to mono equipment of the same signal type shall only be done through a passive combiner.
 - 5. Connections from mono balanced or unbalanced equipment to stereo equipment of the same signal type shall only be done through a passive divider.
 - 6. The Contractor shall provide an isolation transformer for any balanced or unbalanced audio line that exhibits a hum, noise from EMI or RFI, power line noise, or ground loops.
 - 7. The Contractor shall provide an active audio line driver for all balanced and unbalanced signals that exceed the distance limitations of the cabling.
- I. Control System Installation Requirements:
 - 1. The Contractor shall perform calculations for the required wire AWG size based on distance for system power for touch panels, keypads and other devices being powered. A minimum of a 15% overhead is required.

3.4. VIDEO SYSTEM TESTING AND CALIBRATION

- A. All video equipment shall receive proper testing and configuration.
- B. Color Space Optimization:
 - 1. The Contractor shall set the color space of each source and display device to a uniform color space to optimize the switching speed and compatibility of a digital video system. Each device shall be set to an RGB or YCbCr color space depending on the systems primary function and compatibility of the devices.
 - 2. If the primary function of the space is video and other digital media, the color space of each device shall be set to a YCbCr color space. If the primary function of the space is computer-based graphics and presentations, the color space of each device shall be set to an RGB color space.
 - 3. Chroma subsampling shall be set to a consistent 4:4:4 or 4:2:2 across all devices. Set to 4:4:4 when all equipment is capable.
 - 4. If all devices are not capable of displaying a certain color space, all devices shall be set to a common shared color space.
- C. Extended Display Identification Data (EDID) Management:
 - 1. The Contractor shall set the EDID management tables in capable equipment so all sources output the highest common EDID table of the displays.
 - 2. For systems with capable matrix switches, the matrix shall dynamically adjust its EDID tables so any source will output the highest common EDID table of the displays (sinks) being outputted to.
 - 3. If any source or Owner-furnished equipment (OFE) is not outputting properly, the Contractor shall provide and install an EDID Emulator and set it to the highest common EDID table of the displays (sinks) being outputted to.
- D. Projectors, monitors and receivers shall be tested and adjusted for proper signal sync, convergence, brightness, contrast and color level. The Contractor shall adjust all other parameters necessary to achieve a proper video image.
- E. All video source selections shall be tested and verified.
- F. All projectors and displays shall have a minimum burn-in time of 96 hours prior to any adjustments are made and the completion of the project.
- G. All projectors and displays shall have their hue/tint and color/saturation calibrated with a video signal test generator after a minimum warmup time of 20 minutes. Provide all calibrated settings results for each projector and display in the final documentation.
- H. All projectors and displays shall have their brightness, contrast and sharpness calibrated with a video signal test generator after a minimum warmup time of 20 minutes. Provide all calibrated settings results for each projector and display in the final documentation.
- I. All dynamic contrast functions shall be turned off.
- J. Full video calibration for all projectors and displays shall be provided with the following minimum requirements:
 - 1. The Contractor shall utilize non-contact professional video calibration tools such as Sencore OTC1000-CM ColorPro Optical Tri-stimulus Colorimeter or Klein K-10 Tri-stimulus CIE Colorimeter, Sencore or Extron Video and the latest version of ColorPro by CalMan software or pre-approved equal.
 - 2. The projector or display shall have a minimum burn-in time of 96 hours prior to calibration.
 - 3. The projector or display shall have a minimum warmup time of 20 minutes before calibration begins. All efforts shall be taken to allow the display to warm up for a minimum of 60 minutes to allow the luminance to fully stabilize.
 - 4. The space shall be as dark as possible. The colorimeter's ambient light sensor filter shall be recalibrated every 30 minutes when outside ambient light is present to account for the changes in daylight levels.
 - 5. All inputs utilized on the projector or display shall be calibrated using the appropriate video signal, aspect ratio and resolution. Submit results for each input as a separate report.
 - 6. The projector or display shall be calibrated to the Rec. 709 HDTV color standard. White balance shall be calibrated as close as possible to the D65 point for both high IRE and low IRE levels.
 - 7. The projector or display shall have its 3D Color Management calibrated.
 - 8. The projector or display shall have its brightness and contrast adjusted both before and after the gamma is calibrated.
 - 9. Gamma shall be calibrated to an average of 2.2. Gamma shall be verified after the calibration is completed and readjusted as necessary.
 - 10. The projector or display shall have its hue/tint and color/saturation calibrated with a blue lens filter.
 - 11. The Contractor shall submit the final calibration results to the Architect/Engineer for approval and include the approved results in final documentation submitted to the Owner.
 - 12. Calibration by eye is not acceptable.

13. Any setting that cannot be calibrated because the projector or display lacks the functions shall be noted in the final documentation.

3.5. AUDIO SYSTEM TESTING AND CALIBRATION

- A. This Contractor shall field adjust any surface-mounted or flown loudspeaker orientation to achieve the necessary coverage pattern to the intended listening plane. Loudspeakers always face listeners and minimize coverage on walls. The contractor shall be familiar with the named and specified nominal coverage angle of all speakers above its crossover point or for speech range, (500-4,000 Hz).
- B. All speakers shall be tested for polarity prior to high work and a table of test results shall be included for A/E inspection. All loudspeakers shall be connected with uniform polarity, where a positive pressure pulse at the input corresponds to a positive driver excursion, and all drivers are uniform always moving in the same direction. Main speakers shall not be lifted or hoisted into high access areas without polarity testing.
- C. The Contractor shall make incremental adjustments on the equipment output and input tolerances to achieve matching signal levels while preserving +10 dB minimum headroom and also unity gain. Insert all broadband or high pass filters first for system protection after review of manufacturers specifications for power and bandpass.
- D. Provide high quality media with full bandpass program material for critical listening. MP3 or streaming audio is not acceptable. Testing shall illustrate WAV file quality playback for impact and clarity.
- E. The Contractor shall provide graphic plots of the reference ambient noise for each space at the time of the calibration and submit with the calibration results. Test signal shall be 10dB minimum above ambient noise levels during testing.
- F. The Contractor shall use a listener sitting height of four (4) feet \pm 1" for rooms where the primary function will be sitting. The Contractor shall use a listener standing height of five feet three inches (5.25') \pm 1" for rooms where the primary function will be standing.

3.6. DSP-BASED AUDIO PROCESSOR PROGRAMMING

- A. Full system programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.
- B. DSP pathfile with initial settings shall be provided by the Contractor for review by the Architect/Engineer before installation.
- C. The IP-based audio (IEEE AVB, Dante, etc.) and components shall be on a dedicated Virtual LAN (VLAN) for the A/V systems. These components shall be on a dedicated subnetwork of the VLAN. The Contractor shall coordinate these requirements with the Owner prior to installation.
- D. A parametric EQ shall be provided after each crossover point or as approved in the DSP pathfile during shop submittal review. s These shall be utilized to set the speaker output as defined in the Audio System Calibration section within this specification. These equalizers should not be made available to the user to adjust.
- E. Levelers, compressor/limiters, duckers, gates and delays shall be preset during testing and commissioning and are not available for user adjustment following commissioning.
 1. Adjust delays for time of flight plus 8 to 10 ms, typical.
- F. Provide each microphone input with high-pass filter, 5-band parametric EQ, auto-leveler and volume module. Provide line level inputs with high-pass filter, 3-band parametric EQ, compressor/limiter, and volume module.
- G. Acoustic Echo Cancelation (AEC) shall be provided for each conference microphone input.
- H. A broadband pink noise generator shall be provided with a selectable on/off control button within the DSP pathfile. The noise shall be routable through all processing EQs and speaker outputs during testing.
- I. Provide volume meters with labeling for each input and each output.
- J. The Contractor shall utilize the latest version of the programming software.
- K. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.

3.7. DSP-BASED AUDIO PROCESSOR CONTROL SOFTWARE PROGRAMMING

- A. Full system software programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.
- B. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine t the exact page layout requirements prior to the final configuration of the audio system. An Owner sign-off of the final layouts shall be required.
- C. The Contractor shall use the latest version of the software.
- D. At a minimum, there shall be password-protected pages for zone combining, input/output volume control with meters, speaker output volume control with meters, signal routing, signal processing (EQ's, feedback suppression, etc.), and supervision/maintenance for all spaces and combined zones.

3.8. MULTIMEDIA CONTROL SYSTEM INTEGRATION AND PROGRAMMING

- A. Programming and Integration for Control Systems:
1. Full system programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.
 2. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine the exact integration requirements of the control system prior to the installation of the control system and components. An Owner sign-off of the final configuration shall be required.
 3. This section only defines the minimum requirements. The programmer shall provide complete programming for a fully functional system.
 4. The Contractor shall utilize the latest version of the programming software.
 5. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.
 6. The IP-based control system and controlled components shall be on a dedicated Virtual LAN (VLAN) for the A/V systems. These components shall be on a dedicated subnetwork of the VLAN. The Contractor shall coordinate these requirements with the Owner prior to installation.
 7. Integration and programming of the following pieces of equipment shall be provided, with the following with the minimum features and functions:
 - a. All equipment shall include on/off control, except for equipment that must remain active for system functionality.
 - b. Integration of HDCP (High-bandwidth Digital Content Protection) and DPCP (Display Port Content Protection) protected content and sources:
 - 1) No protected sources or content shall be allowed to be selected to route through non-protected devices and displays. A warning shall be displayed stating this information to the user.
 - c. Audio Conference Integration:
 - 1) Refer to DSP Audio Processor Integration for requirements
 - d. Display Integration:
 - 1) The displays shall be integrated into the A/V control system via bi-directional RS-232 or Ethernet control. Provide with the following minimum functions:
 - a) On/off control.
 - b) Display status feedback
 - c) Source switching control
 - d) Audio volume control with mute
 - e) Video mute
- B. Programming and Configuration for Touch Panels:
1. This section only defines the minimum requirements. The programmer shall provide complete touch panel layouts and programming for a fully functional system.
 2. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine the exact touch panel layout requirements prior to the purchase and installation of the touch panel. An Owner sign-off of the final layouts shall be required.
 - a. Vendor shall work with City of Madison IT Media Team to ensure that user interfaces on touch panels are similar in function and appearance to those of other City of Madison facilities.
 3. Contractor logos are not allowed on the touch panels. The Contractor shall coordinate with the Owner on desired logos to be displayed.
 4. All programming for interface and control of all devices shown on the drawings shall be provided. Programming shall be provided for the following minimum functionality:
 - a. The main screen shall include graphical buttons for the primary room functions.
 - 1) Upon selection of the graphical button, all the required functions shall be displayed on the screen. All required equipment shall turn on.
 - b. Master System On/Off Control:
 - 1) When the master system off button is selected, all capable components within the system shall be turned off or placed on standby, except for equipment that is required to remain on for the system to function like the control system processor.
 - c. The main screen shall include graphical buttons for the selection of individual source selections.
 - 1) Upon selection of the graphical button for a source selection, all functional controls for the pieces of equipment, as well as all status indicators, shall be provided in graphical format on the screen.

- 2) Rooms with multiple independent outputs and displays shall have a source routing matrix to allow any input to be routed to any output.
 - d. At all times, on all screens, a button shall be provided to return to the main screen, except for modal pop-ups.
 - e. A master volume control and mute shall be provided at all times on all screens, except for modal pop-ups.
 - f. A master video mute shall be provided at all times on all screens, except for modal pop-ups and audio-only functions.
 - g. A modal countdown timer shall be displayed showing the warmup and cooldown time of the projector. All functions shall be locked out while the projector is in cooldown mode.
 - h. All unused hard buttons shall not be labeled. A blank touch panel bezel shall be provided if no hard buttons are used.
- C. Touch Panel Layout Principles, Considerations and Guidelines:
1. Icons and Buttons:
 - a. Icons shall not be used solely as a button but can be embedded in a button.
 - b. Icons shall appear to be flat and unpressable.
 - c. Status bars or text windows for time, date, room number, and similar information shall appear to be slightly depressed into the screen and appear to be unpressable.
 - d. Buttons shall appear to be pressable by appearing to come off the screen with beveled edges, lighting gradients, and shadows. When pressed, the button shall appear to be depressed into the screen.
 - e. Buttons and icons shall appear to be lit from the top left corner of the screen.
 - f. Buttons shall be grouped together according to general function.
 - g. Button size shall be based on the ratio of Phi (1:1.618) and be sized appropriately based on the screen area and dpi (pixel pitch).
 - h. Maintain a minimum of 5 to 10 pixels between buttons on small to medium touch panels, and a minimum of 10 to 15 pixels between buttons on medium to large touch panels.
 - i. Telephone dialer keypads shall be based on the ITU-T E.161/ANSI TI-703 standard telephone layout and include the a-z letters below each appropriate number.
 - j. TV and radio tuner keypads shall be based on the ITU-T E.161/ANSI TI-703 standard telephone layout, except for the asterisk (*) being replaced by a dot (.) and the pound (#) being replaced with Enter.
 - k. IP-address keypads shall be based on the standard computer keyboard 10-key numeric keypad typically found on the right side of the keyboard.
 - l. Buttons such as Power, Play, Stop, Record, Rewind, Previous, Forward, Eject, Return, Next, Up, Down, Left, Right, Plus, Minus, etc. shall use standard industry symbols. Record shall always be a solid red circle.
 2. Text and Fonts:
 - a. The Contractor shall use a standard sans-serif bold Arial or Calibri font style unless the Owner dictates otherwise.
 - b. Words shall have the first letter capitalized and the rest of the word lower case. No words shall be all capitals or all lower case. Follow standard grammatically correct sentence structure where the first word is capitalized and the rest of the sentence is lower case, followed by the appropriate punctuation mark with accurate syntax and correct verbs.
 - c. All font size in a single group or cluster shall maintain the same font size. Headers to a group or cluster shall have a slightly enlarged font size. and footers shall have a slightly smaller font size in comparison to the group font size to maintain a visual hierarchy.
 3. Color Considerations:
 - a. Colors shall be selected so that, when converted to monochrome, all text, buttons, icons, groups, clusters, borders, etc. are clearly visible to accommodate all color blind or color-impaired individuals and ADA requirements.
 - b. Background colors shall be cool low saturation colors such as grey, blue, or green and their analogous colors, and be a gradient from top down or top left to bottom right.
 - c. Base colors shall be analogous to the background color but be of a higher saturation to stand out more clearly.
 - d. Button colors shall be analogous to the background color, stand out clearly from the base colors, and be of a higher saturation cool color, gray, or a low saturation black.

- e. Icon, symbols, and text color shall be a neutral white or black, or a low saturation grey, and shall clearly stand out from the background or button it is placed on.
- f. Buttons for modal acknowledgement, exit or return, or other modal action shall be a warm color such as red or yellow and their analogous colors.
- g. Buttons, icons, symbols or text for emergency or urgent notifications shall be bright red.
- 4. Pages and Background:
 - a. Groups and clusters shall have clearly defined borders, with spacing between adjacent groups.
 - b. Modal pop-up windows or pages shall be required when a command requires user input before it is executed or when a button has multiple nested elements to control, such as microphone volumes, zone control, lighting and environment control, advanced system controls, etc.
 - 1) The modal pop-up pages shall dim and grey out the background and buttons, overlay the main page, and have a clear back or exit button to bring the user back into the active page the user was on before the modal pop-up.
 - 2) A model pop-up timer page shall appear when a projector is being turned on or off for the appropriate warmup or cooldown time. No additional commands shall be allowed during this time.
 - 3) Model pop-ups shall not replace or completely overlay the background.
 - c. Images or pictures shall never be used as backgrounds to any page other than a master start page, if appropriate.
- 5. Touch Panel Layout Guideline Template:
 - a. IMAGEClient Logo - Static Window
 - b. A/V Source Selection - Static Window
 - c. Display Power, Screen Controls, Light Controls, Shade Controls, and other Environmental Controls – Static Window
 - d. Controls for Selected Source and Status or Home Page - Dynamic Window
 - e. Master Volume and Mute, Video Mute, and Microphone Volume - Static Window
 - f. Home Button - Static Window
 - g. Date, Time, and Room Number - Static Window
 - h. Master System Off - Static Window

3.9. FIELD QUALITY CONTROL

- A. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product that meets the requirements of the specifications, as supplied and warranted by the system vendor. If the product or assembly is not available from the system vendor, provide product or assembly as recommended by the system vendor.
- B. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the Contract Documents.

3.10. FIELD SERVICES

- A. The installer shall conduct a planning meeting with the Owner. The purpose of this meeting shall be to determine all equipment settings that are considered preferences (where proper system operation does not depend on the setting).
- B. The installer shall include labor for all planning and all programming activities required to implement the Owner's preferences for equipment settings.
- C. It shall be the responsibility of the Contractor/installer to provide a complete, functional system as described by the design documents. These responsibilities include:
 - 1. Complete hardware setup, installation and wiring and software configuration.
 - 2. Complete programming of software in accordance with the Owner's desires determined by the planning Meeting.
 - 3. Complete system diagnostic verification.
 - 4. Complete system commissioning.

3.11. SYSTEM ACCEPTANCE

- A. The Contractor shall submit for review a formal acceptance and system checkout procedure. The system checkout procedures shall include all system components and software. The Contractor shall perform the tests and settings and document all results.

3.12. SYSTEM DOCUMENTATION

- A. Complete documentation shall be provided for the system. The documentation shall describe:
 - 1. All operational parameters of the system.
 - 2. Complete documentation of programming and features.
 - 3. Complete operating instructions for all hardware and software.
- B. The following sections shall be provided in the system documentation:
 - 1. User Manual: A step-by-step guide and instructions detailing all system user functions.
 - 2. Technical Manual: A comprehensive document providing all system operations, troubleshooting flowcharts, functional system layout, wiring diagrams, block diagrams and schematic diagrams.
 - 3. Maintenance Manual: A comprehensive document on all aspects of physical maintenance of the systems, including cleaning of the displays, bulb changes, filter cleaning, filter changing and UPS maintenance.

3.13. SYSTEM TRAINING

- A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.
 - 1. Provide two week's advanced notice of training to the Owner and Architect/Engineer.
 - 2. The Architect/Engineer shall be presented with the option to attend the training.
 - 3. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.
- B. At a minimum, the following training shall be conducted:
 - 1. User Manual: A course detailing the system functions and operations that a daily user will encounter.
 - 2. Technical User: Provide configuration training on all aspects of the system(s), including equipment and software.
 - 3. Maintenance User: Provide training on all aspects of physical maintenance of the systems, including cleaning of the displays, bulb changes, filter cleaning and filter changing.
- C. Minimum on-site training times shall be:
 - 1. User Manual: One (1) day.
 - 2. Technical User: One (1) day.
 - 3. Maintenance User: Four (4) hours.
 - 4. The Contractor shall include in his/her bid one (1) additional day of training each quarter for the 12-month period of the project warranty. The Contractor shall return to the site for additional follow-up training during this period.

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SECTION 28 13 00

ACCESS CONTROL SYSTEM (KEYSCAN)

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PART 1 - GENERAL

1.1. SUMMARY

- A. The City of Madison Information Technology Department has been assisting other City agencies with standardizing facilities through the use of access cards, key fobs, and punch pads. All hardware is installed locally at the facility while software controls access to various doors remotely.
- B. These specifications describe the materials, equipment, and installation requirements to install an integrated, computerized access control and alarm monitoring system utilized by the City of Madison Information Technology (CoM-IT) Department.
- C. The ACS System Contractor shall be responsible for verifying equipment requirements, locations, and coordination with the General Contractor and all other necessary trades as needed for a complete installation.
- D. The ACS System Contractor shall be aware that the installation plans and specifications are for two (2) independent buildings on two (2) separate fire alarm systems and shall be wired as such. Refer to the Part 3- Exectuion for additional details.

1.2. RELATED SPECIFICATIONS

- A. 01 31 23 Project Management Web Site
- B. 01 33 23 Submittals
- C. 08 71 00 Door Hardware
- D. 14 21 00 Electric Traction Elevator
- E. 27 05 00 Basic Communication Systems Requirements

1.3. RELATED DRAWINGS

- A. Refer to all Electrical drawings for locations of distribution panels and equipment as it relates to standard line voltage locations.
- B. Refer to all Technical drawings for locations of Access Control System (Keyscan) equipment.
- C. Refer to the door hardware schedule and Architectural floor plans for information relating to door access locations and specific hardware requirements.

1.4. REFERENCES

- A. The system shall comply with the standards, codes and regulations of the following regulatory bodies:
 - 1. Underwriters Laboratories (UL) Std No. 294 – Access Control System Units
 - 2. Canadian Standards Association (CSA) Std C22.2 No. 205-M1983 – Signal Equipment
 - 3. CE Standards
 - a. EN 55022 RF Emissions
 - b. EN 55024 RF Immunity
 - c. EN 60950-1 Equipment Safety
 - 4. FCC Subpart B – RF Emissions
 - 5. Industry Canada ICES 003 Emissions
 - 6. RoHS

1.5. CONTRACTORS QUALIFICATIONS

- A. The Contractor installing the ACS system shall:
 - 1. Be a Certified Keyscan Enterprise Partner
 - 2. Utilize installers who are Keyscan Enterprise Certified Technicians
 - 3. Be based within 25 radial miles of the project location
 - 4. Be able to provide 24/7/365 support during the warranty period of this project
 - 5. Be able to respond and repair or replace most components within 4 hours of notification

1.6. SUBMITTALS

- A. The Contractor shall provide a complete submittal package in a timely manner to allow sufficient review time prior to ordering the system components required for a complete installation. The contractor shall be solely responsible for any equipment, purchased/ordered/delivered that is not approved of during the submittal review process.
- B. The complete submittal package shall include but not be limited to the following:
 - 1. All certifications of the contractor and contractor’s installation team. Certifications shall be current from the start of the contract through the end of the warranty period.
 - 2. Cut sheets indicating, shop drawings, performance data, and other such information that will indicate the component being installed matches the component that was specified.
 - 3. Cut sheets and shop drawing of Contractors recommendations for tags and labels.

1.7. WARRANTY

- A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractors warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
 - 1. The Contractors warranty shall include but not be limited to the following:
 - a. Transportation to and from the location as often as needed during the warranty period.
 - b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
 - c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
 - d. All labor and materials required to remove, repair, replace, or re-install any component.
- B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

1.8. QUALITY ASURANCE

- A. The Contractor shall be responsible for coordinating their Work with other trades and divisions as needed for a complete installation. This shall include pre-installation meetings for locating equipment, conduit, cabling, control devices, and other materials and equipment required by this installation.
- B. The General Contractor (GC) shall be responsible for ensuring that all doors requiring controlled access are properly prepared and installed per the contract documents. The GC shall further be responsible for ensuring all project coordination, pre-installation meetings, submittals and other such project management responsibilities are conducted efficiently and according to the project specifications and schedules.

PART 2 - PRODUCTS

2.1. EXISTING SYSTEM PRODUCTS OVERVIEW

- A. The City of Madison Information Technology Department (CoM IT) owns and operates a fully licensed copy of the Keyscan Access Control System software.
 - 1. The Keyscan Access Control System (ACS) provides controlled access to secured doors and elevators through the use of electronic door latches, proximity readers, control panels, and a proprietary software program.
 - 2. The Keyscan software allows CoM-IT and the facility the Owner to customize multiple levels of access and system performance through any combination of the following:
 - a. Calendar and time based lock/unlock controls
 - b. Group access control for common personnel groups
 - c. Individual access control for specialized access control
 - d. Elevator access control for accessing/not accessing various floors
 - e. Temporarily disable access control for a specified time period
 - f. Remotely unlock/lock a door
 - g. Lockdown a facility from one location
 - h. Provide customizable alert notifications

2.2. NEW EQUIPMENT AND COMPONENTS

- A. The Contractor guarantees that all equipment and components shall be furnished new, undamaged, free of defects, and conform to the drawings and specifications of this contract. The contractor is solely responsible for replacing any damaged or defective item.
- B. New ACS components on interior and exterior access doors shall be able to be integrated with the Owners existing system.

2.3. DISTRIBUTION SUPPLY PANEL (AC-DS-1)

- A. AC-DS-1 brings line voltage into the ACS system with the following performance specifications:
 - 1. Input
 - a. 115VAC, 60Hz, 1.45A
 - 2. Output
 - a. Eight (8) PTC protected outputs
 - b. 16VAC output
 - c. 16VAC @ 10amp (175 VA) supply current (1.25 amp per device, 2.5 amp max.)
 - d. Outputs rated @ 2.5 amp
 - e. Main fuse rated @ 15 amp/32V
 - f. Surge suppression
 - 3. Miscellaneous electrical information
 - a. Operating temperature 0° C to 49°C ambient
 - b. 81.89 BTU/hr
 - c. System AC input VA requirement 166.75 AV
 - 4. Miscellaneous required features
 - a. AC power LED indicators
 - b. Illuminated master power disconnect circuit breaker with manual reset
 - 5. Agency Approvals
 - a. UL 294 listed for Access Control System Units
 - b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
- B. AC-DS-1 shall be:
 - 1. Altronix, AL168175CB
 - 2. Pre-approved equal

2.4. POWER SUPPLY PANEL (AC-PS-1)

- A. The AC-PS-1 brings line voltage from the AC-DS-1, reduces then distributes the voltage to the Access Security Panels (AC-SEC-1) with the following performance specifications:
 - 1. Input
 - a. 115VAC, 60Hz, 1.9A
 - b. Power supply input options
 - i. One (1) common power input for ACM8 and lock power (factory installed)

- ii. Two (2) isolated power inputs; one (1) to power the ACM8 and one (1) for lock accessory power, (external power supply is required). Current is determined by the power supply connected, not to exceed a maximum of 10 amp total
 - c. Eight (8) Access control System trigger inputs with the following options:
 - i. Eight (8) normally open (NO) inputs
 - ii. Eight (8) open collector inputs
 - iii. Any combination of the above
 - 2. Output
 - a. 12VDC or 24VDC @ 6 amp supply current
 - b. Eight (8) independently controlled outputs with the following options:
 - i. Eight (8) Fail-Safe and/or Fail-Secure power outputs
 - ii. Eight (8) form "C" 5 amp rated relay outputs
 - iii. Any combination of the above
 - c. Eight (8) auxiliary power outputs (un-switched)
 - d. Output fuses rated @ 3.5 amp
 - e. Filtered and electronically regulated outputs (built-in power supply).
 - 3. Miscellaneous electrical information
 - a. Operating temperature 0° C to 49°C ambient
 - b. BTU/hr:
 - i. 12VDC = 36.85 BTU/hr
 - ii. 24VDC = 73.70 BTU/hr
 - c. ACM8 board main fuse is rated at 10 amp
 - 4. Battery Backup
 - a. Built-in charger for sealed lead acid or gel type batteries
 - b. Power supply board maximum charge current 0.7 amp
 - c. Automatic switch over to stand-by battery when AC fails
 - d. Zero voltage drop when unit switches over to battery backup (AC failure condition)
 - e. Battery fail and battery presence supervision (form "C" contact)
 - 5. Miscellaneous required features
 - a. Fire Alarm disconnect (latching or non-latching) is individually selectable for any or all of the eight (8) outputs.
 - b. Fire Alarm disconnect input options:
 - i. Normally open (NO) or normally closed (NC) dry contact input
 - ii. Polarity reversal input for FACP signaling circuit
 - c. Alarm output relay indicates that FACP input is triggered (form "C" contact rated @ 1 amp 28VDC)
 - d. Short circuit and thermal overload protection
 - e. AC fail supervision (form "C" contact)
 - f. Red LEDs indicate outputs are triggered (relays energized)
 - g. Green LED indicates FACP disconnect is triggered
 - h. AC input and DC output LED indicators
 - i. Enclosure accommodates up to two (2) 12AH batteries
 - 6. Agency Approvals
 - a. UL 294 listed for Access Control System Units
 - b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
 - B. AC-PS-1 shall be:
 - 1. Altronix, AL600ULACM
 - 2. Pre-approved equal
- 2.4A. READER POWER SUPPLY PANEL (AC-RPS-1)
 - A. The AC-RPS-1 brings lines voltage into the ACS to provide power to HID Signo readers. The power supply shall have the following performance specifications:
 - 1. Input
 - a. 115VAC, 60Hz, 3.5A
 - 2. Output
 - a. 12VDC or 24VDC selectable output
 - b. 6A continuous supply current
 - c. Filtered and electronically regulated output.
 - d. Short circuit and thermal overload protection.

3. Battery Backup
 - a. Built-in charger for sealed lead acid or gel type batteries.
 - b. Automatic switch over to stand-by battery when AC fails.
 4. Supervision
 - a. AC fail supervision (form "C" contacts).
 - b. Notification trigger is selectable for 30 seconds (factory set) or 6 hours.
 - c. Low battery supervision (form "C" contacts).
 - d. Battery presence supervision (form "C" contacts).
 5. Visual Indicators
 - a. AC input and DC output LED indicators.
 6. Temperature
 - a. Operating 0 degrees C to 49 degrees C (32 degrees F to 120 degrees F).
 - b. Storage -20 degrees C to 70 degrees C (-4 degrees F to 158 degrees F).
 - c. Relative Humidity 85% +/- 5%.
 - d. BTU/Hr (approx.):
12VDC: 37 BTU/Hr.
24VDC: 74 BTU/Hr.
 - e. System AC Input VA requirement: 402.5VA.
- B. AC-RPS-1 shall be:
1. Altronix AL600ULX
 2. Pre-approved equal
- 2.5. SECURITY PANEL (AC-SEC-1)**
- A. The AC-SEC-1 distributes the reduced voltage and control wiring to/from each door with an access control device.
 - B. AC-SEC-1 shall be:
 1. Keyscan CA8500 – 8 Reader Access Control Panel
 - C. The AC-SEC-1 shall be provided, located and mounted by the Contractor.
- 2.5A. SECURITY PANEL (AC-SEC-2)
- A. The AC-SEC-2 distributes the reduced voltage and control wiring to/from each door to an IT telecommunications room.
 - B. AC-SEC-2 shall be:
 1. Keyscan CA150 – Single Door Access Control Panel
 - C. The AC-SEC-2 shall be provided, located and mounted by the Contractor.
- 2.6. ELEVATOR FLOOR ACCESS CONTROL PANEL (EFACP)**
- A. The EFACP distributes the reduced voltage and control wiring to the elevator equipment for providing access control to specific floors while providing general public access to others.
 - B. EFACP shall be:
 1. Keyscan EC1500 – 1 Cab Elevator Floor Access Control Panel
 - C. The EFACP shall be provided, located and mounted by the Contractor in the elevator machine room (B11).
 - D. The EFACP requires two (2), 16.5 VAC, 37 or 40VA transformers to be supplied and installed by the Contractor.
- 2.7. DOOR CONTROL DEVICES**
- A. The Contractor shall be responsible for verifying the Door Control Device (DCD) quantities and locations with the door hardware schedule.
 - B. DCD shall be:
 1. HID Global 40KTKS-00-000000– Signo 40 wall mount keypad reader, this reader accepts swipe monitoring of cards, key fobs, and other such devices as well as accepting personal identification numbers (PINs). If a keypad is not needed, the HID Global 40TKS-00-000000 Signo 40 or 20TKS-00-000000 Signo 20 can be used.
 - i. Plan designation = AC-CR1-W
 2. The 40KTKS-00-000000, shall be used for all locations including the elevator cab.
- 2.8. DOOR CONTROL CABLES**
- A. The following cables are required for a complete installation of the ACS, per controlled door, as follows:
 1. One (1) 22/6 shielded cable, required; to DCD
 2. One (1) 18/2 un-shielded cable, required; lock power

3. One (1) 22/2 un-shielded cable, required; door contact
 4. One (1) 22/4 un-shielded cable, required but not used; for future request to exit sensors
- B. At the Contractors option they may run a manufactured cable bundle containing all four (4) cables listed above. It shall be the sole responsibility of the contractor to appropriately size the conduits for the installation.

PART 3 - EXECUTION

3.1. COOPERATION OF THE ACS CONTRACTOR

- A. The Contractor shall be required to coordinate with all trades for a complete and timely installation. This includes attending all pre-installation meetings where equipment locations, conduit locations, and control devices will be installed or may be in conflict with the installation of other trades. The Contractor shall be solely responsible for any additional cost required for removing/replacing/modifying any completed work by other trades because the installation was not properly coordinated.
- B. The Contractor shall coordinate with the Owners Representative from City IT for all information necessary to complete the installation and integration with the Owners existing hardware and software.
- C. The Contractor shall verify with the appropriate Owners Representative for mounting heights of all hardware and equipment prior to installation. This shall be completed at a pre-installation walk through prior to rough-in.
- D. The Contractor shall coordinate with the Owner's Representative from City IT to verify all requirements for all access controlled doors are properly coordinated and understood prior to roughing in the installation.

3.2. GENERAL EQUIPMENT MOUNTING

- A. All ACS equipment shall be mounted to the 3/4" AC fire rated plywood panels provided and installed by the General Contractor. Contractor shall tape out all equipment prior to mounting to insure adequate space is allotted for the complete installation per the riser diagrams including all related conduits and cables.
- B. The EFACP shall be mounted to the 3/4" AC fire rated plywood panels provided and installed by the General contractor in the elevator Equipment Room. The General Contractor shall coordinate the location of the plywood panels with the Elevator Equipment Contractor and the ACS Contractor prior to installation.
- C. All equipment shall be neatly arranged so as to meet or exceed the manufacturer's recommended working space around each component.
- D. Equipment to be installed on plywood mounting panels shall include but not be limited to the following:
 1. Distribution Service Panel (AC-DS-1)
 2. Power Supply Panel (AC-PS-1)
 - 2a. Reader Power Supply Panel (AC-RPS-1)
 3. Access Control Panel (AC-SEC-1)
 4. Elevator Control Panel (EFACP), including transformers
 5. All required conduits, and boxes for line voltage

3.3. GENERAL CONDUITS AND WIRING

- A. This section shall apply to both the ACS Contractor and the Electrical Contractor. The following division of responsibilities shall apply:
 1. The Electrical Contractor shall be responsible for furnishing, installing, and connecting all conduits, connectors, conductors, and other related materials associated with providing line voltage to the ACS system as follows:
 - a. Providing an 110V, 15A, dedicated circuit from the designated distribution panel to AC-DS-1 and AC-RPS-1 as described in Section 2.3 above.
 - b. Providing line voltage from AC-DS-1 to AC-PS-1 as described in Section 2.4 above.
 - c. Providing and installing the required 110V, 20A dedicated duplex outlet in the elevator Equipment Room (B11). Coordinate the location with the ACS Contractor and the Elevator Contractor.
 2. The ACS Contractor shall be responsible for furnishing installing, and connecting all conduits, connectors, conductors and other related materials required to complete the installation of the low voltage wiring and door controller cabling.
- B. All conduits shall be properly sized for the number of wires or wire bundles being pulled through the conduit. The Contractor shall verify with the manufacturer the recommended fill rate by conduit size and shall not exceed the recommendations.
- C. The contractor shall neatly lay out all conduits in such a fashion so as to minimize bending, crossovers, etc.
- D. Bends, pull boxes, and pull points shall be sized and located as per all applicable codes and standards for the number of wires or wire bundles in the bend, pull box, pull point.

- E. CAT6 cables from each AC-SEC-1 and the EFACP shall be neatly run in cable management equipment supplied and installed by the cabling contractor or conduits supplied and installed by the ACS Contractor as needed. The switch to be used for all ACS equipment shall be located in Telecom Room 021. Cables shall be labeled on both ends per the cabling specification.
- F. The General Contractor and the ACS Contractor shall ensure the following Emergency Access requirements are properly installed and operational prior to the final Madison Fire Department inspection for occupancy.
 - 1. CoM IT shall provide a minimum of six (6) swipe cards to each installed Knox Box for emergency entrance. The cards shall be appropriately coded for entry at all controlled access doors.
 - 2. The following doors shall be wired to unlock in the event of an emergency.
 - a.

3.4. EQUIPMENT IDENTIFICATION AND LABELING

- A. The Contractor shall provide and install all equipment identification and labeling to the following specifications.
 - 1. Tags and labels shall be permanent rigid plastic or metal tags with engraved or machine stamped lettering. Hand written self stick or metal hand stamped tags will not be accepted.
 - 2. The Contractor shall work out the labeling scheme for doors with City IT, Owner, and Architect prior to ordering any labels or tags.
 - 3. The Contractor shall provide all labels and tags associated with this specification. This shall include the line voltage feed to each AC-DS-1 from the electrical distribution panel.
- B. Panels and Boxes
 - 1. All panels and boxes shall be labeled on the outside cover that readily identifies the panel/box as a "Distribution Supply", "Power Supply", "Access Control Panel", "Elevator Floor Access Control Panel", etc. An associated number shall also be on each tag and the number "1" shall be used even if there is only one of that type panel/box.
 - 2. Access Control Panels shall have a card index inside the front cover of each door indicating the controller number, door number, and door location being served by that panel.
- C. Conduits
 - 1. Line voltage from electrical distribution panels shall have conduits labeled on both ends as follows:
 - a. At the distribution panel the line voltage conduit shall be labeled with the system supplied, and the ACS distribution supply panel number.
 - b. In the Telecommunications Room the line voltage conduit label shall indicate the distribution panel and circuit number(s) controlling the supply line.
 - 2. Conduits between Access Control Panels and the controlled doors shall be labeled on both ends as follows:
 - a. In the Telecommunications Room each conduit shall be labeled with the door number(s) being supplied.
 - b. Above the finished ceiling where the conduit is exposed prior to going into the wall space that serves the door the conduit shall be labeled with the Door Control Panel and Controller number associated with the door being served.
 - c. If the conduit size is reduced as control cabling is supplied to doors along the run each change in conduit size shall be re-labeled as noted in 2.b. above.
 - 3. Conduits between equipment and components in the Telecommunications Room do not need to be identified.

3.5. INSTALLATION TESTING AND ACCEPTANCE

- A. The CoM IT and the Owner shall be responsible for completing all software programming associated with the installation of this contract prior to the completion of the installation of the system components. It is the sole responsibility of the Contractor to notify the Owner no less than two (2) weeks in advance of completing the installation that all codes and time setting shall be prepared for final installation and testing.
- B. The Contractor, CoM IT, and the Owner shall test each access control point with swipe cards and PINs to insure the door unlocks.
- C. CoM IT shall test each door using the existing fully integrated software. This shall include but not be limited to the following:
 - 1. Remotely lock/unlock the doors
 - 2. Verify time clock feature works for locking doors
 - 3. Verify swipe cards and PINs work on all doors
 - 4. Verify emergency entrance cards for Knox boxes work on all doors for the areas served.
- D. The Contractor, CoM IT, and the Owner shall test the elevator floor access functions as follows:

1. With swipe cards and PINs to ensure controlled access to all floors.
 2. With no swipe cards or PINs to ensure that the general public can only access the designated public floors and not controlled access floors.
 3. Verify time clock feature works for accessing floors
- E. A completed and accepted installation shall pass all of the above tests for all controlled access points.
- F. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION

**SECTION 31 05 00
COMMON WORK RESULTS FOR EARTHWORK**

PART 1 - GENERAL

1.1 SCOPE

- A. This section provides information common to two or more technical site work specification sections or items that are of a general nature, and not included in other sections. This section applies to ALL site work, as applicable. Included are the following topics:

PART 1 GENERAL

- Scope
- Related Work
- Referenced Organizations
- Referenced Documents
- Quality Assurance
- Safety
- Permits
- Construction Limits
- Submittals
- Off-Site Storage
- Codes
- Certifications and Inspections

PART 2 MATERIALS

- Barricades, Signs, and Warning Devices
- Temporary Plastic Barrier Fencing

PART 3 EXECUTION

- Maintenance of Site Access/Egress
- Continuity of Existing Traffic/Parking and Traffic Control
- Protection and Continuity of Existing Utilities
- Protection of Existing Work and Facilities
- Stormwater/Excavation Water Management

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.
1. Section 31 20 00 - Earthmoving
 2. Section 31 22 16.15 - Subgrade Preparation
 3. Section 32 91 19 - Topsoil-Select Fill Materials and Application

1.3 REFERENCED ORGANIZATIONS

- A. Applicable provisions of Division 1 shall govern all work under this section.
- B. Abbreviations of organizations referenced in these specifications are as follows:
- | | |
|--------|--|
| AASHTO | American Association of State Highway and Transportation Officials |
| ACPA | American Concrete Pipe Association |
| ANSI | American National Standards Institute |
| ASCE | American Society of Civil Engineers |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| AWWA | American Water Works Association |
| AWS | American Welding Society |
| FHA | Federal Highway Administration |
| EPA | Environmental Protection Agency |
| NEC | National Electric Code |
| NEMA | National Electrical Manufacturers Association |
| NFPA | National Fire Protection Association |
| NSF | National Sanitation Foundation |
| OSHA | Occupational Safety and Health Administration |
| STI | Steel Tank Institute |

1	UL	Underwriters Laboratories Inc.
2	WDNR	State of Wisconsin Department of Natural Resources
3	WISDOT	State of Wisconsin Department of Transportation
4		

5 **1.4 REFERENCED DOCUMENTS**

- 6 A. Where reference is made to the "Construction Standards", it shall be construed to mean the City of Madison's
7 Construction Standards, as they may pertain, except the method of measurement and basis of payment shall not
8 apply.
9 B. Where reference is made to the "Standard Specifications", it shall be construed to mean the pertinent section of
10 the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, and all
11 supplemental and interim supplemental specifications, as they may pertain, except the method of measurement
12 and basis of payment shall not apply.
13 C. Where reference is made to the "State Specifications", it shall be construed to mean the pertinent section of the
14 Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and
15 interim supplemental specifications, as they may pertain, except the method of measurement and basis of
16 payment shall not apply.
17 D. Where reference is made to the "Geotechnical Report", it shall be construed to mean the geotechnical report
18 provided in Section 02 32 00.
19

20 **1.5 QUALITY ASSURANCE**

- 21 A. Provide materials and products as required by individual specification sections. Refer to General Conditions of
22 the Contract regarding substitutions.
23 B. Provide quality assurance testing and reporting as required by individual specification sections.
24

25 **1.6 SAFETY**

- 26 A. Contractor is solely responsible for worksite safety.
27 B. Perform all work in accordance with applicable OSHA, state and local safety standards.
28 C. Contact Diggers Hotline at 1-800-242-8511 in accordance with statutory requirements. Request that non-
29 member utilities and private utilities be located by the appropriate parties.
30

31 **1.7 PERMITS**

- 32 A. Unless otherwise noted in the Contract Documents, Owner shall be responsible for obtaining and paying for all
33 permits necessary to complete the work.
34

35 **1.8 CONSTRUCTION LIMITS**

- 36 A. Construction Limits are defined by lines denoted as Construction Fencing/Limits of Disturbance as indicated on
37 the Drawings. In the absence of such a designation on the Drawings, confine work to the minimum area
38 reasonably necessary to undertake the work as determined by the City's Construction Representative. In no
39 case shall construction activities extend beyond property lines or construction easements.
40 B. The Contractor shall restore all disturbed areas in accordance with the Drawings and Specifications. If Drawings
41 and Specifications do not address restoration of specific areas, these areas will be restored to pre-construction
42 conditions as approved by the City's Construction Representative.
43 C. Coordinate work under this project with work by City's Construction Representative and other contractors
44 providing separate work on the site related to other contracts.
45

46 **1.9 SUBMITTALS**

- 47 A. Refer also to Section 00 72 00 - General Conditions and Division 1.
48 B. Submit manufacturer's shop drawings, product data, samples, substitutions and Operation and Maintenance
49 (O&M) data for approval as required by individual specification sections.
50 C. Submittals shall be provided to the Owner's Construction Representative for review and approval, unless
51 otherwise directed. Submittals shall be sent electronically by email in *.pdf format unless otherwise directed.
52

53 **1.10 OFF-SITE STORAGE**

- 54 A. Refer to Division 1.
55 B. In general, the payments for materials stored off-site will only be considered in instances where there is limited
56 space available for storage on the site. Prior approval by the Owner's Construction Representative, together
57 with the execution of a Storage Agreement will be required.
58

1 **1.11 CODES**

- 2 A. Comply with the requirements of all applicable, local, state, and federal codes.

3
4 **1.12 CERTIFICATIONS AND INSPECTIONS**

- 5 A. Refer to Section 00 72 00 - General Conditions.
6 B. Obtain and pay for all required sampling, testing, inspections, and certifications except those expressly listed as
7 provided by the Owner or City in the Contract Documents. Deliver originals of certificates and documents to the
8 City's Construction Representative within three days; provide copies to the Owner's Construction
9 Representative. Include copies of the certifications and documents in the O&M Manual.

10
11 **PART 2 - MATERIALS**

12
13 **2.1 BARRICADES, SIGNS, AND WARNING DEVICES**

- 14 A. Traffic barricades, traffic signs, and warning devices shall meet the requirements of current applicable OSHA
15 standards and MUTCD.

16
17 **2.2 TEMPORARY PLASTIC BARRIER FENCING**

- 18 A. UV stabilized high-density polyethylene barrier fence free of holes tears and other defects. Provide 5-foot tall
19 fence in diamond or rectangular pattern. Fencing shall be "safety orange" color, unless otherwise noted.
20 B. Posts for temporary plastic barrier fencing shall be 5 feet tall, minimum 12-gauge, painted metal posts.

21
22 **PART 3 - EXECUTION**

23
24 **3.1 MAINTENANCE OF SITE ACCESS/EGRESS**

- 25 A. Unless otherwise shown or directed, maintain existing access and egress to the facility throughout construction.
26 Contact the City of Madison and Owner prior to any construction activities to obtain directives for preferred
27 access to the site. Maintain ANSI A117 compliant access to the high school site for disabled persons, delivery
28 access, emergency vehicle access, and emergency egress. Do not interrupt access and egress without prior
29 written approval from the Owner's Construction Representative.

30
31 **3.2 CONTINUITY OF EXISTING TRAFFIC/PARKING**

- 32 A. Refer also to Section 02 20 00 - General Sitework Requirements.
33 B. Do not interrupt or change existing traffic, delivery, or parking without prior written approval from the City or
34 Owner's Construction Representative. When interruption is required, coordinate schedule with the City and
35 Owner's Construction Representative to minimize disruptions. When working in public right-of-way, obtain all
36 necessary approvals and permits from the City if not provided by the Owner.
37 C. When Contractor's activities impede or obstruct traffic flow, Contractor shall provide traffic control devices,
38 signs, and flaggers in accordance with other Contract Documents and current applicable OSHA standards and
39 MUTCD. Contractor shall be responsible for all costs associated with temporary traffic control. All barricades,
40 signs, and warning devices shall be included under the traffic control bid item.

41
42 **3.3 PROTECTION AND CONTINUITY OF EXISTING UTILITIES**

- 43 A. Verify the locations of any water, drainage, gas, sewer, electric, drainage, gas, sewer, electric,
44 telephone/communication, fuel, steam lines or other utilities and site features which may be encountered in any
45 excavations or other sitework. All lines shall be properly underpinned and supported to avoid disruption of
46 service.
47 B. Do not interrupt or change existing utilities without prior written approval from the City's Construction
48 Representative, affected utilities, and users. Notify all users impacted by outages a minimum of 48 hours in
49 advance of outage. Notification shall be provided in writing and describe the nature and duration of outages
50 and provide the name and number of Contractor's foreman or other contact.
51 C. Any service connections encountered which are to be removed shall be cut off at the limits of the excavation and
52 capped in accordance with the requirements of applicable codes and any specifications governing such
53 removals.

54
55
56 **3.4 PROTECTION OF EXISTING WORK AND FACILITIES**

- 57 A. Verify the locations of, and protect, any signs, paved surfaces, buildings, structures, landscaping, streetlights,
58 utilities, and all other such facilities that may be encountered or interfered with during the progress of the work.

1 Take measures necessary to safeguard all existing work and facilities that are outside the limits of the work or
2 items that are within the construction limits but are intended to remain. Report any damage to existing facilities
3 to the City’s Construction Representative immediately. Correct and pay for all damages.
4

5 **3.5 STORMWATER/EXCAVATION WATER MANAGEMENT**

- 6 A. Control grading around structures, pitch ground to prevent water running into excavated areas.
- 7 B. Pits, trenches within building line, and other excavations shall be maintained and free of water.
- 8 C. Provide trenching, pumping, other facilities required.
- 9 D. Notify Owner’s Construction Representative in the event that springs or running water are encountered in
10 excavation; provide discharge by trenches, drains, pumping to point outside of excavation. Provide information
11 to Owner’s Construction Representative of points and areas that water will be discharged. At the Owner and
12 City’s Construction Representative’s option, the Contractor shall drain the spring to the storm sewer system by
13 the use of field tile.
- 14 E. Establish and maintain an onsite Erosion Control Maintenance Log. The log shall document erosion control
15 installation locations and date of establishment, rainfall event dates and amounts, erosion control failure
16 locations, corrective measures taken and weekly inspection documentation. This log shall be available onsite
17 during the entire construction process and available to the Owner, Owner’s Construction Representative,
18 Governing Municipality, and authorized WDNR staff.
- 19 F. Be responsible for control measures to prevent damage from flooding, erosion, and sedimentation to on-site
20 and off-site areas.

21 **END OF SECTION**
22

**SECTION 31 20 00
EARTHMOVING**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Stripping of topsoil and stockpiling.
 2. Excavation, preparation, backfilling, and compaction of subgrades per the Geotechnical Report.
 3. Cutting, filling, grading, and compaction for drives, walks, roads, and parking subgrade.
 4. Cutting, filling, grading, and compaction for landscaping area subgrade ready for topsoil.

1.2 RELATED SECTIONS include the following:

- A. Section 02 20 00 - General Sitework Requirements
B. Section 31 10 00 - Site Clearing
C. Section 31 25 00 - Erosion Control

1.3 STANDARD SPECIFICATIONS

- A. Where reference is made to the "Construction Standards", it shall be construed to mean the City of Madison's Construction Standards, as they may pertain, except the method of measurement and basis of payment shall not apply.
- B. Where reference is made to the "Standard Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- C. Where reference is made to the "State Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- D. Where reference is made to the "Geotechnical Report", it shall be construed to mean the geotechnical report in Section 02 32 00.
- E. All construction of public facilities and/or work within public lands or rights of way shall conform to the requirements and conditions of the Standard Specifications stated above with the most stringent applying.
- F. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
1. ASTM International (ASTM):

ASTM D422	Particle Size Analysis of Soil
ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft/lbf/ft ³ (600 kN.m/m ³))
ASTM D1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2,700 Kn.m/m ³))
ASTM D2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	Description and Identification of Soils (Visual-Manual Procedures)
ASTM D4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
 2. American Association of State Highway and Transportation Officials (AASHTO):

AASHTO T 88	Particle Size Analysis of Soils
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 3. National Fire Protection Association (NFPA):

NFPA 70	National Electrical Code
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 4. American Water Works Association (AWWA):

AWWA C200	Standard for Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C206	Field Welding of Steel Water Pipe

1.4 SUBMITTALS

- A. Submit documentation of materials meeting the required specifications.

- 1 B. Testing:
2 1. The City shall provide testing for work performed for public improvements.
3 2. The Contractor shall provide quality control testing as defined in the Contract Documents.
4 3. The Contractor shall coordinate work and testing requirements with the Owner's Construction
5 Representative and City's testing agency.
6

7 **1.5 DEFINITIONS**

- 8 A. Backfill: Soil materials used to fill an excavation.
9 B. Base Course: Course placed between the sub-grade and the hot-mix asphalt, concrete pavement, walks, or
10 curbs.
11 C. Breaker Run Stone: Meet the requirements defined in Wisconsin Department of Transportation (WisDOT)
12 Section 311.
13 D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
14 E. Excavation: Removal of material encountered above the subgrade elevations and to lines and dimensions
15 indicated.
16 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and
17 dimensions as directed by Owner's Construction Representative. Authorized additional excavation and
18 replacement material will be paid for according to Contract provisions.
19 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and
20 dimensions without direction of Owner's Construction Representative. Unauthorized excavation, as well
21 as remedial work directed by the Owner's Construction Representative, shall be without additional
22 compensation.
23 F. Fill: Soil materials used to raise existing grades.
24 G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill
25 immediately below subbase, drainage fill, or topsoil materials.
26 H. Topsoil: Excavated on-site material, free of large tree roots, rocks, subsoil, debris, and weeds.
27

28 **1.6 CONTOURS (GRADE ELEVATIONS)**

- 29 A. Contours indicated on drawings are the finished grade elevations. Contractor shall review all grade elevations
30 before commencing to ensure that proper slopes for drainage, slope for drives, walks, paving, etc., are
31 maintained. If Contractor believes a deficiency is apparent, they shall notify the City or Owner's Construction
32 Representative for clarification.
33

34 **PART 2 - PRODUCTS**

35
36 **2.1 SOIL MATERIALS**

- 37 A. General: All materials shall conform to requirements of the Geotechnical Report.
38 B. Materials:
39 1. Fill and Backfill: Satisfactory materials excavated from the site.
40 2. Imported Fill Material: Satisfactory material provided from off-site borrow areas when sufficient
41 satisfactory materials are not available from required excavations.
42 3. Trench Backfill: ASTM D2321 and the Standard Specifications, unless otherwise specified or shown on
43 the Drawings.
44 4. Subgrade Sub-base Material: As required by the Geotechnical Report and/or Section 31 22 16.15.
45 5. Building Sub-base Material: Sub-base for building and appurtenances slabs on ground is specified in
46 Section 03 30 00 or the Geotechnical Report as applicable.
47 6. Bedding: Aggregate type as indicated on the plans or naturally or artificially graded mixture of natural or
48 crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100% passing a 1-
49 inch sieve and not more than 8% passing a No. 200 sieve.
50 7. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM
51 D448; coarse-aggregate grading Size 57; with 100% passing a 1½-inch sieve and 0% to 5% passing a No. 8
52 sieve.
53 8. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand;
54 ASTM D448; coarse-aggregate grading Size 67; with 100% passing a 1-inch sieve and 0% to 5% passing a
55 No. 4 sieve.
56 9. Topsoil: Topsoil shall consist of stripping material excavated from the site. Topsoil shall consist of
57 organic surficial soil found in depth of not more than 6 inches. Topsoil shall be as further defined in
58 Section 32 91 19 - Topsoil-Select Fill Materials and Application.

- 1 C. Where conflicts between this specification, the Drawings and the Geotechnical Report exist, requirements of the
2 Geotechnical Report shall govern.
- 3 D. Source Quality Control:
- 4 1. Laboratory testing of off-site materials proposed for use in the project shall be provided by the
5 Contractor's testing consultant. Test results shall be provided to the Owner's Construction
6 Representative for approval before incorporation into the work.
- 7 2. The following tests shall be performed on each type of imported soil material used as compacted fill:
8 Moisture and Density Relationship: ASTM D698 or ASTM D1557
9 Mechanical Analysis: AASHTO T88 or ASTM D422
10 Plasticity Index: ASTM D4318
11

12 **PART 3 - EXECUTION**

13 14 **3.1 GENERAL**

- 15 A. General: All work shall be executed and conform to requirements of the Geotechnical Report.
- 16 1. Where conflicts between this specification and the Geotechnical Report exist, requirements of the
17 Geotechnical Report shall govern.
- 18 2. For any material provided by the Owner, the Contractor shall provide a minimum of five days' notice for
19 the material and shall include the quantity of material and delivery location requested for each day.
20 Delivered material shall be available Monday-Friday 7:00 a.m. to 3:30 p.m. unless otherwise agreed upon
21 by both the Owner and Contractor."
22

23 **3.2 PREPARATION**

- 24 A. Subgrades, fill material, and grading for pavement, ramps, sidewalks, and structures shall conform to the
25 recommendations in the Geotechnical Report.
- 26 B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral
27 movement, undermining, washout, and other hazards created by earthwork operations.
- 28 C. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating
29 materials as necessary.
- 30 D. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water
31 runoff or airborne dust to adjacent properties and walkways.
32

33 **3.3 CLEARING AND GRUBBING**

- 34 A. Limits of clearing and grubbing shall be areas which are affected by excavation and grading.
- 35 B. Refer to Section 31 10 00 - Site Clearing.
- 36 C. Remove trees, stumps, roots, brush, other vegetation, debris, existing foundations, pavements, fences, and
37 other items which interfere with new construction.
- 38 D. Remove stumps, logs, roots, and other organic material including existing structure occurring outside the
39 structure excavation to depths below the following:
40 1. Walks: 18 inches
41 2. Roads and Drives: 18 inches
42 3. Parking Areas: 36 inches
43 4. Lawn Areas: 12 inches
44 5. Concrete Pads: 24 inches
45 6. Depressions within areas shall be filled and compacted as specified under Controlled Backfill.
- 46 E. Removal of existing trees which are to remain will not be permitted. Notify Owner's Construction
47 Representative if existing trees create a difficulty when grades are raised or lowered in excess of 6 inches.
48

49 **3.4 DEWATERING**

- 50 A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and
51 from flooding Project site and surrounding area.
- 52 B. All dewatering activities must meet all the requirements set forth in the WDNR Construction Site Erosion &
53 Sediment Control Technical Standard 1061. The Contractor shall obtain any necessary permits for dewatering.
- 54 C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation:
55 1. Reroute surface water runoff away from excavated areas.
56 a. Do not allow water to accumulate in excavations.
57 b. Do not use excavated trenches as temporary drainage ditches.

1 blasting caps shall be used. The Contractor shall obtain written approval prior to performing any blasting and
2 shall notify the Owner's Construction Representative a minimum of 24 hours prior to blasting. The plan shall
3 contain provisions for storing, handling and transporting explosives as well as for the blasting operations.
4

5 **3.6 STRIPPING OF SITE**

- 6 A. Strip the site in conformance with the requirements of the Geotechnical Report referenced in Section 02 32 00.
7 B. Strip those portions of the site which will occupy walks, roads, drives, parking areas and where grade changes
8 are to be made, by a minimum of depth of topsoil indicated by the soils report plus additional soil as required to
9 reach soil free of roots or organic debris subject to rotting and settling.
10 C. Stockpile reusable topsoil for use in finish grading and restoration. Reusable topsoil shall be fertile, friable
11 agricultural soil capable of sustaining vigorous plant growth and suitable for growth of grass, neither excessively
12 alkaline or acidic, free from subsoil, clay lumps, gravel, brush, objectionable weeds, litter, stones larger than
13 1 inch in diameter, and other material. Do not permit surplus topsoil to leave the project site until the finish
14 grading is nearing completion or unless otherwise approved in writing by the Owner's Construction
15 Representative.
16 D. Do not excavate, grade, or work topsoil in frozen or muddy conditions.
17

18 **3.7 ROCK IN EXCAVATIONS**

- 19 A. When rock as defined above is encountered before the proper subgrade is reached, work shall proceed as
20 follows:
21 1. The excavation shall stop at this point and it shall be determined if such material is classified as rock.
22 2. Material classified as rock shall be removed to the lines and grades indicated to permit installation of
23 permanent construction without exceeding the following dimensions:
24 a. 24 inches outside of concrete forms.
25 b. 6 inches outside of minimum required dimensions of concrete cast against grade.
26 c. 6 inches beneath the bottom of concrete slabs on grade.
27

28 **3.8 UTILITY ROCK EXCAVATIONS**

- 29 A. When rock as defined above is encountered when excavating for water main or storm sewer, work shall proceed
30 as follows:
31 1. The excavation shall stop at this point and it shall be determined if such material is classified as rock.
32 2. Material classified as rock shall be removed to 6 inches below the proposed utility location to permit
33 installation of the utility without exceeding the following dimensions:
34 a. 8 feet in width centered on the proposed utility.
35 b. 6 inches beneath the bottom of the proposed water main or storm sewer.
36 c. Utility rock excavations shall be completed in accordance with Section 608 of the State
37 Specifications.
38

39 **3.9 EXCAVATION FOR WALKS AND PAVEMENTS**

- 40 A. Excavations shall be in conformance with the requirements of the Geotechnical Report referenced in Section
41 02 32 00.
42 B. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.
43

44 **3.10 SUBGRADE INSPECTION**

- 45 A. Notify Owner's Construction Representative when excavations have reached subgrade.
46 B. If Owner's Construction Representative determines that unsatisfactory soil is present, continue excavation and
47 replace with compacted backfill or fill material as directed.
48 C. Proof-roll shall be completed in accordance with Geotechnical Report referenced in Section 02 32 00 and in
49 accordance with Section 31 22 16.15 - Subgrade Preparation.
50 D. Authorized additional excavation and replacement material will be paid for according to the Contract provisions.
51 E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction
52 activities, as directed by the Owner's Construction Representative, without additional compensation from the
53 Owner.
54

55 **3.11 STORAGE OF SOIL MATERIALS**

- 56 A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without
57 intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
58 Provide necessary erosion control devices as shown on the Erosion Control Plan.

1 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

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3.12 BACKFILL

- A. Backfill shall be in conformance with the requirements of the Geotechnical Report referenced in Section 02 32 00.
- B. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Removing trash and debris.
 - 2. Removing deleterious materials.

3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench, or break up sloped surfaces steeper than one vertical to four horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations per the Geotechnical Report.
- D. Fill areas to contours and elevations shown on the Drawings with materials deemed satisfactory.
- E. Place fills in continuous lifts specified herein.
- F. Fill within proposed building subgrade, paving subgrade, and outparcel subgrades shall not contain rock or stone greater than 6 inches in any dimension.
- G. Unless otherwise specified for rock fill, rock or stone less than 12 inches in largest dimension may be used in fill below structures, paving, outparcels, and graded areas, up to 24 inches below surface of proposed subgrade of hard surface paved areas or 24 inches below finish grade of landscape and turf graded areas when mixed with satisfactory material. Rock or stone less than 4 inches in largest dimension may be used in fill within the upper 24 inches of proposed subgrade or finish grade of graded areas when mixed with satisfactory material.
- H. Rocks larger than 12 inches in diameter shall be separated and stockpiled at an onsite location determined by the Owner's Construction Representative.
- I. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 12 inches.

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2% of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2% and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact as follows:

Percent (%) of Maximum Laboratory Density

<u>Location</u>	<u>ASTM D698</u>	<u>ASTM D1557</u>
Subgrade and fill below foundations, slab-on-grade, and upper 12 inches of area to be paved	98	95
Subgrade and fill in all other areas	95	92

- D. Maintain moisture content of not less than 1% below and not more than 2% above optimum moisture content of fill materials to attain required compaction density.
- E. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.
- F. Corrective Measures for Non-Complying Compaction: Remove and re-compact deficient areas until proper compaction is obtained.

57
58

1 **3.16 GRADING**

- 2 A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with
3 compaction requirements and grade to cross sections, lines, and elevations indicated.
4 1. Provide a smooth transition between adjacent existing grades and new grades.
5 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
6 B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to
7 required elevations within the following tolerances:
8 1. Lawn or Unpaved Areas: ±1 inch (25 mm).
9 2. Walks: ±1 inch (25 mm).
10 3. Pavements: ±1/2 inch (13 mm).

11
12 **3.17 FINISH GRADING**

- 13 A. Grade areas where finish grade elevations or contours are indicated on the Drawings, other than paved areas,
14 outparcels, and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded
15 areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Ground surfaces shall
16 vary uniformly between indicated elevations. Grade finished ditches to allow for proper drainage without
17 ponding and in manner that will minimize erosion potential. For topsoil, sodding, and seeding requirements
18 refer to Sections 32 92 00 and Section 32 92 19.
19 B. Correct settled and eroded areas within one year after date of completion at no additional expense to the City.
20 Bring grades to proper elevation.
21

22 **3.18 MAINTENANCE OF SUBGRADE**

- 23 A. Verify finished subgrades to ensure proper elevation and conditions prior to construction above subgrade.
24 B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and
25 other construction equipment. If rutting or damage to the subgrade does occur, regrade and compact to project
26 specified tolerances.
27 C. Construct temporary ditches and perform such grading as necessary to maintain positive drainage away from
28 subgrade at all times. Contractor shall be responsible for maintaining grades and subgrades throughout
29 construction from frost, moisture and excessive wheel loading. Contractor shall be responsible for choosing
30 means, methods and best management practices to protect the subgrade.
31

32 **3.19 BORROW AND SPOIL SITES**

- 33 A. Comply with WPDES and local erosion control permitting requirements for any and all on-site and off-site,
34 disturbed spoil and borrow areas. Upon completion of spoil or borrow operations, clean up spoil or borrow
35 areas in a neat and reasonable manner to the satisfaction of the Developer or off-site property owner, if
36 applicable.
37 B. Topsoil stripping and re-spread will be paid for at the quantity and unit price noted on the Bid Form. Excavation
38 shall be paid as part of the Lump Sum price for Excavation Common as noted on the Bid Form. Seeding and
39 mulching shall also be paid at the unit prices noted in the Bid Form.
40

41 **3.20 PROTECTION**

- 42 A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and
43 debris.
44 B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become
45 eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather
46 conditions.
47 1. Scarify or remove and replace soil material to depth as directed by Owner's Construction Representative;
48 reshape and recompact.
49 C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with
50 additional soil material, compact, and reconstruct surfacing.
51 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate
52 evidence of restoration to the greatest extent possible.
53

54 **3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- 55 A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris,
56 and legally dispose of it off Owner's property.
57
58

- 1 **3.22 FIELD QUALITY CONTROL**
2 A. Field quality control shall be the responsibility of the Owner’s Construction Representative. Except for specified
3 mandatory testing, field quality control testing and inspection shall be at the discretion of the Contractor as
4 necessary to assure compliance with Contract requirements.
5 B. The Owner’s testing agency will perform retesting and re-inspection as necessary until corrections are fully
6 completed by the Contractor at the Contractor’s expense.
7

8 **END OF SECTION**

**SECTION 31 22 16.15
SUBGRADE PREPARATION**

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete roadway and parking lot grading, as required in these specifications, on the Drawings and as otherwise deemed necessary to complete the work.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section:
1. Section 01 00 00 - General Requirements
 2. Section 02 32 00 - Geotechnical Investigation
 3. Section 31 25 00 - Erosion Control
 4. Section 31 23 16.13 - Trenching
 5. Section 31 20 00 - Earthmoving
 6. Section 31 32 00 - Soil Stabilization

1.3 QUALITY ASSURANCE

- A. The Contractor shall retain the services of a geotechnical consulting engineer to conduct sampling testing and analysis as required by this section and elsewhere in the Contract Documents. The geotechnical consulting engineer shall meet the requirements of ASTM E329-00b.

Material	Test Required	Test/Sample Frequency
Granular Fill	D422-63(1998) - Standard Test Method for Particle Size Analysis of Soils	1 test/500 cy placed
Granular Fill	ASTM D1557 - Optimum Moisture-Maximum Density Determination (Modified Proctor)	1 test per type of material

Table 31 22 16.15 – 1

1.4 REFERENCES

- A. Where reference is made to the "Construction Standards", it shall be construed to mean the City of Madison's Construction Standards, except the method of measurement and basis of payment shall not apply.
- B. Where reference is made to the "Standard Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- C. Where reference is made to the "State Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- D. Where reference is made to the "Geotechnical Report", it shall be construed to mean the Geotechnical Report in Section 02 32 00.
- E. ASTM International (ASTM):
1. ASTM D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbs/ft³ (600 kN-m/m³)).
 2. ASTM D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/ft³ (2,700 kN-m/m³)).
 3. ASTM D6938 – In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.5 PERMITS/FEES

- A. Contractor shall be solely responsible for obtaining all permits necessary to complete the work that are not provided by the Owner. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to, permits for work within public right-of-way, and building permits.

- 1 B. The Owner will obtain and provide the WDNR WRAPP permit, City Erosion Control and Stormwater permits, and
2 Wisconsin Department of Safety and Professional Services Exterior Plumbing permit.
3

4 **1.6 PROVISIONS FOR FUTURE WORK**

5 None.
6

7 **1.7 SURVEY AND STAKING**

- 8 A. Owner will provide benchmarks and control points for the project as defined in Division 1.
9 B. Contractor shall be responsible for transferring benchmarks, control points, lines, and grades as necessary to
10 complete his work.
11

12 **PART 2 - MATERIALS**

13
14 **2.1 AGGREGATE MATERIALS - GENERAL**

- 15 A. Alternate crushed aggregate material blends that are locally available will be considered on a project by project
16 basis for crushed aggregate base courses, and will be subject to the City's approval. The Owner's Construction
17 Representative will require the Contractor to furnish a gradation report on the materials.
18

19 **2.2 SPECIAL FILL**

- 20 A. In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades,
21 backfilling, undercut excavations or filling behind retaining walls. Fill materials shall meet the requirements of
22 the following sections of the State Specifications: Section 209 for Granular Backfill, Section 210 for Structure
23 Backfill, Section 305 for Dense Graded Base Course, Section 312 for Select Crushed Material, and Section 311 for
24 Breaker Run of the State Specifications.
25

26 **2.3 GEOTEXTILE FABRIC**

- 27 A. See Section 31 32 00 - Soil Stabilization.
28

29 **PART 3 - EXECUTION**

30
31 **3.1 PREPARATION**

- 32 A. Review plans and prepare work plan and schedule. Coordinate any necessary interruptions in site access with
33 Owner's Construction Representative, in accordance with other specification sections.
34 B. Contact Diggers Hotline. Locate and protect utilities, structures, pavement, trees, landscaping, benchmarks, and
35 other features in the work area.
36 C. Layout work. Establish and transfer line and grade as necessary to complete the work.
37 D. Remove topsoil from work area. Sawcut and remove pavement from work area.
38 E. Grade roadways and parking areas to drain water away.
39

40 **3.2 PREPARE FOUNDATION FOR ASPHALTIC PAVEMENT**

- 41 A. Provide all labor, materials, and equipment necessary to prepare the foundation for to a condition suitable for
42 constructing and supporting asphaltic pavement in accordance with these Specifications and Section 211 of the
43 State Specifications.
44

45 **3.3 EXCAVATION**

- 46 A. Excavate to elevations and dimensions as shown on the Drawings and as necessary to complete construction.
47 Excavations shall be sufficiently deep to provide for all proposed base course and pavement.
48 B. Notify the Owner's Construction Representative if correction of unauthorized excavation or over-excavation is
49 necessary. Said excavations will be corrected based on recommendations of the Owner's Construction
50 Representative or Owner's Geotechnical Consultant. Contractor will be responsible for all costs associated with
51 correcting these excavations, including fees charged by City and/or Owner's Geotechnical Consultant.
52 C. Segregate the various materials excavated. Reserve material meeting the requirements of backfill for the
53 location. Excavated material that does not meet the requirements of backfill, and excess excavated material,
54 shall be removed from the site and disposed by the contractor, unless directed otherwise by other specification
55 sections or the Owner's Construction Representative.
56 D. Locate spoil piles in accordance with OSHA requirements, and so that it does not interfere with public travel,
57 adjacent landowners or other construction activities.
58

3.4 FILL AND COMPACTION

- A. Excavation shall be reasonably free of water prior to beginning filling. Do not place material on frozen surfaces or use frozen material.
- B. Fill areas using the material specified on Table 31 22 16.15 - 2, or as shown on the Drawings.
- C. Place and compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Hand-place and compact material as necessary.
- D. Place backfill simultaneously on both sides of structures.
- E. Moisture condition backfill material as necessary to achieve density required for given use.
- F. Compact fill material as required by Table 31 22 16.15 - 2 for the given use. Compaction requirements based on Modified Proctor Dry Density (ASTM D1557).
- G. It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified density. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines confined spaces (i.e., backfilling undercut areas) and other features.

Area	Percent (%) Compaction (1)	
	Clay/Silt	Sand/Gravel
<u>Within 10 ft. of building lines</u>		
Footing bearing soils	95	95
Under floors, steps and walks		
- Lightly loaded floor slab	95	95
- Heavily loaded floor slabs and thicker fill zones	95	95
<u>Beyond 10 ft. of building lines</u>		
Under walks and pavements - Granular Fill		
- Less than 2 ft. below subgrade	95	95
- Greater than 2 ft. below subgrade	92	92

Table 31 22 16.15 – 2

- H. Where additional filling or excavation is necessary, or placement of base course will be delayed, roll surface of proposed roadway with a smooth drum roller to provide relatively impervious surface and promote drainage. Roll with a smooth single drum vibratory roller having a minimum operating static weight of 12,000 pounds and a minimum centrifugal force of 22,000 pounds to provide relatively impervious surface and promote drainage. In the event the material is deficient in moisture content for readily obtaining the necessary density, it shall be moistened to the degree necessary by means of approved equipment. The compaction operation shall continue until the Engineer observes no visible displacement of material laterally or longitudinally under the compaction equipment or hauling equipment.

3.5 SUBGRADE APPROVAL/PROOF-ROLLING

- A. Prior to undercutting or excavating below subgrade (EBS) or placing any base course, contact the Owner’s Construction Representative to schedule inspection of subgrade and proof-rolling. Provide minimum of 24 hours confirmed notice. All proof-rolling shall be completed in the presence of the Owner’s Construction Representative or Owner’s Geotechnical Consultant.
- B. To complete proof-rolling, entire roadway subgrade shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof-rolling.
- C. Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof-rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with “tag” or “pusher” axles retracted from the ground.
- D. Test rolling shall be accomplished in a series of traverses parallel to the centerline of the street or parking area. The truck shall traverse the length of the street or parking area once for each 12 feet of width. Additional passes along the traverse shall be completed as directed by the Owner’s Construction Representative, to further define unsatisfactory subgrade.
- E. Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in subsequent subsections of this specification.

1 F. Once the subgrade has been proof-rolled and approved, protect the soils from becoming saturated, frozen, or
2 adversely altered.
3

4 **3.6 UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS)**

- 5 A. Undercutting/EBS shall be completed only when directed by the Owner’s Construction Representative. The
6 Contractor shall not be compensated for any unauthorized undercutting/EBS. Measure and document undercut
7 areas and depths in consultation with Owner’s Construction Representative.
8 B. Payment for undercutting/EBS shall be made on a unit price (cubic yard) basis measured in place at the rate as
9 defined in the Contract. Payment will be made only for the measured quantity of undercutting/EBS directed by
10 the Owner’s Construction Representative to be performed. The unit price shall include all costs for labor and
11 materials necessary to remove and replace undercut areas including providing backfill materials and disposal of
12 excavated materials off site.
13 C. Excavate undercut areas to the depth specified using equipment with smooth cutting edge. Excavated undercut
14 material that does not meet the specifications for fill needed elsewhere on site shall be removed from the site
15 and legally disposed.
16 D. Undercut areas shall be backfilled with 3-inch dense graded base course, as directed by the Owner’s
17 Construction Representative in maximum of 6-inch thick lifts (compacted) or as directed by the Owner’s
18 Construction Representative. Three-inch dense graded base course shall be compacted in thin lifts with a
19 vibratory compactor until no further consolidation is evident.
20

21 **3.7 GEOTEXTILE FABRIC**

- 22 A. When required by the Owner’s Construction Representative geotextile fabric shall be installed over the subgrade
23 layer and prior to installing base aggregates. The Owner’s Construction Representative shall determine if
24 geotextile fabric installation is required at the time of subgrade proof-rolling.
25
26

END OF SECTION

**SECTION 31 25 00
EROSION CONTROL**

PART 1 - GENERAL

1.1 SUMMARY

- A. Related sections:
 - 1. Section 31 20 00 - Earthmoving
 - 2. Section 31 32 00 - Soil Stabilization
 - 3. Section 32 92 19 - Seeding and Sodding

1.2 REFERENCE STANDARDS

- A. Where reference is made to the "Construction Standards", it shall be construed to mean the City of Madison's Construction Standards, except the method of measurement and basis of payment shall not apply.
- B. Where reference is made to the "Standard Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- C. Where reference is made to the "State Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- D. Where reference is made to the "Geotechnical Report", it shall be construed to mean the geotechnical report in Section 02 32 00.

1.3 SUBMITTALS

- A. Provide a detailed Erosion Control and Sequencing Plan for approval by the Owner's Construction Representative, if differing from the approved sequencing and erosion control plans issued as part of the Contract Documents.
- B. Provide manufacturer's data and WisDOT Product Acceptability List verification for silt fence, temporary ditch checks and erosion mat for review and approval by Owner's Construction Representative prior to procurement.
- C. Identify seed supplier and provide seed source, purity and germination specifications, for all seed mixes specified for installation in this section, to Owner's Construction Representative for approval prior to procurement.
- D. Provide manufacturer's data for fertilizer for review and approval by Owner's Construction Representative prior to procurement.

1.4 QUALITY ASSURANCE

- A. Contractor shall ensure that the General Provisions and Special Conditions of the following permits issued for the project shall be complied with at all times:
 - 1. City of Madison Stormwater Management and Erosion Control Permit.
 - 2. WDNR General Permit to discharge under the Wisconsin Pollutant Discharge Elimination System, for land disturbing construction activities.
- B. Inspect erosion control materials and supplies after delivery to verify that no damage has occurred.
- C. The status of erosion control measures will be an item of discussion in every weekly construction meeting. All corrective actions required during construction meetings shall be accomplished within three working days of the meeting date.
- D. Contractor shall provide weekly written reports on the erosion control system for the previous week to the Owner's Construction Representative for the duration of construction in a format approved by the Engineer. These reports shall be provided at each weekly construction meeting and shall be reported to the City's erosion control reporting representative (electronic PDF preferred). The weekly erosion control report shall describe:
 - 1. The extent of erosion control system installed.
 - 2. The condition of erosion control measures for that week, based on field observations.
 - 3. Any accidental release of sediment.
 - 4. A summary of daily rainfall/snowmelt data for the week.
 - 5. Any specific corrective action taken.
 - 6. Corrective action that needs to be taken.
 - 7. The person that conducted the observations shall sign the report.

1 **1.5 WARRANTY**

- 2 A. Work conducted under this section shall be subject to the one-year warranty provisions described in the General
3 Conditions of contract.

4 **1.6 SEQUENCING AND SCHEDULING**

- 5 A. The sequencing of project construction activities will be generally as described in the plans and Contract
6 Documents. The specific sequence for construction within a particular area shall be agreed upon with Owner's
7 Construction Representative prior to construction within that area.
8 B. All erosion control measures shall be completely installed for each construction area and approved by Owner's
9 Construction Representative before any other construction activity takes place.

10
11 **PART 2 - PRODUCTS**

12
13 **2.1 MATERIALS**

- 14 A. Silt Fence:
15 1. Silt fence shall be as specified in the WDNR Construction Site Erosion & Sediment Control Technical
16 Standard 1056.
17 B. Erosion Mat - Class I - Type B and Class II Type B:
18 1. Erosion control mat shall be to the requirements of WDNR Construction Site Erosion & Sediment Control
19 Technical Standard 1052.
20 2. WisDOT Erosion Mat Class 1 Type B erosion mat meeting the requirements of Section 628.2.2 of the State
21 Specifications shall be used for all seeded areas within the public right-of-way unless noted otherwise on
22 the plans.
23 C. Seeding Temporary:
24 1. Temporary seed shall be 100% Annual Ryegrass, with purity and germination requirements as specified in
25 Section 630.2.1.5.1.2 of the State Specifications or as indicated in the WDNR Construction Site Erosion &
26 Sediment Control Technical Standard 1059. Temporary seeding will be incidental to the grading items in
27 the contract.
28 D. Mulch:
29 1. Mulch proposed for use shall be clean straw, with no weed material or seeds, and shall be approval
30 Engineer before use.
31 2. Mulch shall meet the standards set forth within the WDNR Construction Site Erosion & Sediment Control
32 Technical Standard 1058.
33 E. Tracking Pads:
34 1. Stone for use in temporary access pads shall range in size from 3 inches to 6 inches in diameter.
35 2. Pad shall be a minimum of 50 feet long.
36 3. Pad shall meet the requirements of WDNR Construction Site Erosion & Sediment Control Technical
37 Standard 1057.
38 F. Fertilizer - Type A:
39 1. Fertilizer shall be as specified in Section 629.2.1.2 of the State Specifications for Fertilizer, Type A.
40 G. Riprap:
41 1. Provide riprap as specified in Section 606.2.1 of the State Specifications for the size and type indicated on
42 the construction drawings or bid form. If the size is not specified, medium riprap shall be used.
43 H. Temporary Ditch Checks:
44 1. Provide temporary ditch checks of material found on WisDOT's PAL list.
45 2. Submit a written copy of the proposed material and manufacturer's specification for installing the
46 product on slopes channels, and next to live traffic lanes as applicable to the project to the Owner's
47 Construction Representative for approval prior to installation.
48 3. Erosion Bales shall not be used on this project as a sole means of perimeter erosion control. Erosion
49 bales may be used to reinforce or support other primary means of perimeter erosion control, like silt
50 fence.
51 I. Inlet Protection – Ridig Framed:
52 1. Use FlexStorm Catch-It ridig framed temporary inlet protection complying with ASTM D8057. Contractor
53 shall provide inlet protection to fit the existing drainage structures.
54 J. Rock Check Dams:
55 1. Provide rock check dams in accordance with the standard detail drawings at locations identified in the
56 plans and as directed by the Owner's Construction Representative.
57
58

1 **PART 3 - EXECUTION**

2
3 **3.1 GENERAL**

- 4 A. Establish all heights and grades to properly execute work from benchmark established by others.
5 B. Contractor shall provide all surveys to accurately locate the construction on the site.
6 C. Provide temporary erosion control measures in accordance with the Contractor's approved erosion control and
7 sequencing plan. These measures may include temporary sedimentation basins, diversion berms and swales and
8 other measures constructed in accordance with the WDNR Technical Standards.
9

10 **3.2 EROSION CONTROL STRUCTURES**

- 11 A. Runoff diversion berms shall be constructed of clean topsoil, 2 feet high, with 3H:1V side slopes, and seeded and
12 mulched immediately after installation.
13 B. Silt fence shall be placed according to the WDNR Construction Site Erosion & Sediment Control Technical
14 Standard 1056.
15

16 **3.3 SEEDING TEMPORARY AND MULCHING**

- 17 A. Temporary seeding shall be conducted as described in Section 630.3.3 of the State Specification, with sowing
18 using either Method A or Method B. Temporary seeding areas shall receive fertilizer at the rate of 10 lbs./1,000
19 sq. ft.
20 B. Temporary seed shall receive mulch at the rate of 2,500 lbs./acre, and shall be crimped into the soil using
21 WisDOT Procedure specified in Section 627.3.2.3 of the State Specifications.
22 C. Disturbed areas within the construction site shall be graded, prepared for seeding, and seeded to conform to the
23 following requirement for the maximum duration of bare-ground conditions:
24 1. Areas within 100 feet of and draining directly to wetlands or watercourses, with slopes less than 5%:
25 seven days
26 2. Areas within 100 feet of and draining directly to wetlands or water courses, with slopes between 5% and
27 25%: three days
28 3. Areas in the interior of the site that do not drain directly to wetlands and water courses: 30 days.
29

30 **3.4 EROSION MAT CLASS I TYPE B and CLASS II TYPE B**

- 31 A. Erosion control mat shall be applied according to WDNR Technical Standards 1052 or 1053 as applicable and
32 manufacturer's requirements.
33

34 **3.5 TRACKING PAD**

- 35 A. Install tracking pads at the locations as shown in the plans or as directed by the Owner's Construction
36 Representative.
37 B. Tracking Pads shall be installed and maintained in accordance with Section 628.3.16 of the State Specification.
38 C. Tracking Pads shall be maintained throughout construction and removed once construction is completed or the
39 adjacent work area is stabilized.
40

41 **3.6 FERTILIZER TYPE A**

- 42 A. Fertilizer applied to temporary seeding areas shall be applied as specified in Section 629.2.1.2 of the State
43 Specification at locations where temporary seeding is required.
44

45 **3.7 RIPRAP**

- 46 A. Place riprap of the specified size at locations as shown in the construction drawings.
47 B. Place riprap in accordance with Section 606.3 of the State Specifications.
48 C. Riprap at outfall locations shall be placed immediately after or concurrent with the placement of the apron
49 endwall. Riprap at the outfalls is intended to be left in place as a permanent erosion control measure.
50

51 **3.8 TEMPORARY DITCH CHECKS**

- 52 A. Place and maintain temporary ditch checks at the locations shown on the construction drawing and as directed
53 by the Owner's Construction Representative
54 B. Place and maintain temporary ditch checks in accordance the manufacturer's instructions and Section 628.3.14
55 of the State Specifications, except erosion bales are not to be used as temporary ditch checks on this project.
56 C. Remove ditch checks after the slope ditches are stabilized in accordance with Section 628.3.14 of the State
57 Specifications.
58

- 1 **3.9 INLET PROTECTION – RIGID FRAMED**
2 A. Furnish install and maintain ridged framed inlet protection in accordance with Flex-Storm Catch-it manufactures
3 specifications, and City of Madison and Dane County requirements.
4 B. Inlet protection shall be maintained throughout construction, and removed once the area adjacent to the inlet
5 has been stabilized and as directed by the Owner’s Construction Representative.
6

- 7 **3.10 MAINTENANCE AND CLEANUP**
8 A. The erosion control system shall be maintained throughout the duration of the construction project, in
9 accordance with the procedures identified in Section 628.3.4.2 of the State Specifications.
10 B. The erosion control system shall be inspected immediately after each rainfall of more than 0.5 inch, and daily
11 during prolonged rainfall. All inspections shall be reported to the Owner’s Construction Representative in the
12 weekly erosion control system report.
13 C. Accumulated sediment within the erosion control system shall be removed before one-half of the storage
14 capacity of the erosion control measure is used, or as specified by the Owner’s Construction Representative.
15 D. Accumulated sediment in riprap shall be removed as directed by the Owner’s Construction Representative
16 during the project, and as a final condition of acceptance if deficiencies are noted at final walk through.
17

- 18 **3.11 ROCK CHECK DAMS**
19 A. Place and maintain rock check dams at the locations shown on the construction drawing and as directed by the
20 Owner’s Construction Representative
21 B. Remove sediment deposits when the build-up reaches approximately one-third of the height of the rock check
22 dam, and as directed by the Owner’s Construction Representative. Contractor may also remove and replace the
23 stone check with sediment and replace with new stone at their discretion. Each location will be paid for initial
24 placement only maintenance is incidental to this item.
25 C. Remove rock check dams after the slopes and ditches are stable and turf develops enough to make future
26 erosion unlikely. The Owner’s Construction Representative will determine when the contractor meets this
27 criteria.
28
29

END OF SECTION

**SECTION 31 32 00
SOIL STABILIZATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
1. Geotextile fabric and geogrid for stabilization of subgrade.
- B. Related requirements:
1. Section 31 20 00 – Earthmoving

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. Where reference is made to the “State Specifications”, it shall be construed to mean the pertinent section of the Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.

1.3 SUBMITTALS

- A. Submit manufacturer’s specifications for geotextile fabric and geotextile grid.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide products from one of the following manufacturers as specified in the Materials paragraph below:
1. TenCate Geosynthetics North America (Mirafi), Pendergrass, GA - (706) 693-2226, www.tencate.com
 2. Hanes Geo Components (WEBTEC), Winston Salem, NC - (336) 747-1600, www.hanesgeo.com
 3. Tensar International Corp., Atlanta, GA - (888) 828-5126, www.tensarcorp.com
 4. Thrace-LINQ Inc., Summerville, SC - (843) 873-5800, www.thracelinq.com
 5. DuPont (Tygar), Summerville, SC - (843) 832-6860, www.tygargeo.com
 6. Synteen Technical Fabrics, Lancaster, SC - (800) 796-8336, www.synteen.com

2.2 MATERIALS

- A. Aggregate:
1. Coarse Aggregate: Crushed carbonate, crushed gravel, crushed air-cooled slag, granulated slag, a mixture of crushed and granulated slag, or other types of suitable material meeting the gradation requirements of Section 305 of “State of Wisconsin Standard Specifications for Highway and Structure Construction”, latest edition.
 2. Fine Aggregate: Sand - Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter meeting the gradation requirements of Section 305 of “State of Wisconsin Standard Specifications for Highway and Structure Construction”, latest edition.
 3. Subsoil: Existing to be re-used.

2.3 ACCESSORIES

- A. Geotextile Fabric for Stabilization - provide one of the following:
1. Mirafi HP 370 or HP 570, by TenCate
 2. SF40 or SF65, by DuPont
 3. GTF-200 or 300, by Thrace-LINQ
 4. TerraTex HD, by Hanes
- B. Geogrid for Stabilization - provide one of the following:
1. Biaxial Geogrid Type 1 (formerly BX 1100), by Tensar
 2. Biaxial Geogrid Type 2 (formerly BX 1200), by Tensar
 3. Mirafi BXG 11, by TenCate
 4. Mirafi BXG 12, by TenCate
 5. SF 11, by Synteen
 6. SF 12, by Synteen

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PART 3 - EXECUTION

3.1 PREPARATION

- A. Start stabilization only when weather and soil conditions are favorable for successful application of proposed material.
- B. Proof-roll subgrade to identify areas in need of stabilization.

3.2 EQUIPMENT

- A. Perform operations using suitable, well maintained equipment capable of excavating subsoil, mixing and placing materials, wetting, consolidating, and compacting of material.

3.3 EXCAVATION

- A. Excavate subsoil to depth sufficient to accommodate soil stabilization.
- B. Remove lumped subsoil, boulders, and rock that interfere with achieving uniform subsoil conditions.
- C. Notify Owner’s Construction Representative in writing of unexpected subsurface conditions. Discontinue affected work in area until notified to resume work.
- D. Remove excess excavated material from site.

3.4 GEOTEXTILE FABRIC AND/OR GEOGRID

- A. Place geotextile fabric and/or geogrid over subsoil surface, lap edges and ends in accordance with manufacturer’s recommendations in those areas that are shown on Construction Drawings or in those areas that need additional stabilization prior to placement of base course. Place geotextile fabric and/or geogrid in accordance with manufacturer’s recommendations.

3.5 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance. Except for specified mandatory testing, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. The Owner’s Construction Representative specified below shall not be considered a substitute for the Contractor’s responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

3.6 TESTING

- A. Field Density: Field in-place density shall be determined as specified in Section 31 20 00 - Earthmoving.

END OF SECTION

**SECTION 32 11 23
AGGREGATE BASE COURSE**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes provisions for providing aggregate base course as the foundation for hot-mixed asphalt paving, concrete curb and gutter, and concrete sidewalk.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 - Specification Sections, apply to this Section.
- B. Related Sections - The following sections contain requirements that relate to this Section:
1. Section 02 20 00 – General Sitework Requirements
 2. Section 03 30 00 – Cast-In-Place Concrete
 3. Section 31 20 00 – Earthmoving
 4. Section 31 22 00 – Soil Stabilization
 5. Section 32 12 16.13 – Plant-Mix Asphalt

1.3 REFERENCES

- A. Where reference is made to the "Construction Specifications", it shall be construed to mean the pertinent section of the City of Madison's Standard Construction Specifications, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- B. Where reference is made to the "Standard Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- C. Where reference is made to the "State Specifications", it shall be construed to mean the pertinent section of the WisDOT Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- D. Where reference is made to the "Geotechnical Report", it shall be construed to mean the geotechnical report in Section 02 32 00.
- E. ASTM:
1. ASTM D1557-78: Test Methods for Moisture-Density relation of Soil and Soil-Aggregate Mixtures Using 10 lbs. (4.54-kg) Rammer and 18-in. (457 mm) Drop.
 2. ASTM D698: Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbs/ft³ (600 kN-m/m³)).
 3. ASTM D1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/ft³ (2,700 kN-m/m³)).
 4. ASTM D6938: In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
1. Submit 50-pound samples of each type of aggregate to testing laboratory for materials not obtained from on-site stockpiles and for blended aggregate.
 2. Weight slips of each load showing the net weight of the aggregate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials meeting the requirements of the Geotechnical Report and WisDOT Sections 301, 305, and 306 and as shown in the Drawings.
1. Reclaimed or recycled asphalt products will not be an acceptable alternative or equal to 1¼ Dense Grade Base material.

**SECTION 32 16 00
CONCRETE PAVEMENT, CURB AND SIDEWALKS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Portland cement concrete pavements, curbs, gutters, and sidewalks, except sidewalks on structural footings and stoops and/or specified by the architectural or structural drawings.
- B. Related requirements:
 - 1. Section 02 20 00 - General Site Work Conditions
 - 2. Section 02 32 00 - Geotechnical Investigation
 - 3. Section 31 20 00 - Earthmoving
 - 4. Section 31 22 16.15 - Subgrade Preparation
 - 5. Section 32 11 23 - Aggregate Base Course

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Concrete Institute (ACI):
 - 1. ACI 305R Hot Weather Concreting
 - 2. ACI 306R Cold Weather Concreting
 - 3. ACI 306.1 Cold Weather Concreting
 - 4. ACI 308 Curing Concrete
- C. ASTM International (ASTM):
 - 1. ASTM A185 Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 2. ASTM A615 Deformed and Plain Billet-Steel for Concrete Reinforcement
 - 3. ASTM C31 Making and Curing Concrete Test Specimens in the Field
 - 4. ASTM C39 Comprehensive Strength of Cylindrical Concrete Specimens
 - 5. ASTM C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - 6. ASTM C94 Ready-Mixed Concrete
 - 7. ASTM C138 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
 - 8. ASTM C143 Slump of Hydraulic Cement Concrete
 - 9. ASTM C231 Air-Content of Freshly Mixed Concrete by the Pressure Method
 - 10. ASTM C172 Sampling Freshly Mixed Concrete
 - 11. ASTM C173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - 12. ASTM C260 Air-Entraining Admixtures for Concrete
 - 13. ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete
 - 14. ASTM C618 Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
 - 15. ASTM C989 Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
 - 16. ASTM C1064 Temperature of Freshly Mixed Portland Concrete Cement
 - 17. ASTM C1218 Water-Soluble Chloride in Mortar and Concrete
 - 18. ASTM D98 Calcium Chloride
 - 19. ASTM D994 Preformed Expansion Joint Filler for Concrete (Bituminous)
 - 20. ASTM D1190 Concrete Joint Sealer, Hot Poured, Elastic Type
 - 21. ASTM D1751 Performed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
 - 22. ASTM D2628 Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
- D. Federal Specifications (FS):
 - 1. FS HH-F-341 Fillers, Expansion Joint: Bituminous (Asphalt and Tar)
- E. Wisconsin Department of Transportation (WisDOT):
 - 1. State of Wisconsin Standard Specifications for Highway and Structure Construction, latest edition.

1.3 SUBMITTALS

- A. Mix Design:
 - 1. Fill out and submit attached Concrete Mix Design Submittal Form.
 - 2. Submit three (3) copies of each proposed mix.

- 1 3. Submit separate mix design for concrete to be placed by pumping in addition to the mix design for concrete to be placed directly from the truck chute.
- 2
- 3 4. Include applicable information shown on the Mix Design Submittal Form and the following:
 - 4 a. Proportions of cementitious materials, fine and coarse aggregate, and water.
 - 5 b. Water-cementitious material ratio, 28-day compressive design strength, slump, and air content.
 - 6 c. Type of cement, fly ash, slag and aggregate.
 - 7 d. Aggregate gradation.
 - 8 e. Type and dosage of admixtures.
 - 9 f. Special requirements for pumping.
 - 10 g. Range of ambient temperature and humidity for which design is valid.
 - 11 h. Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product specified.
 - 12 i. Materials and methods for curing concrete.
- 13
- 14 B. Submit certified laboratory test data or manufacturer's certificates and data for the items listed below certifying that materials are in conformance requirements specified herein. Submit to the Engineering Consultant of Record and the Construction Testing Laboratory for review and approval and within seven calendar days after receipt of Notice to Proceed.
 - 15 1. Concrete mix design(s)
 - 16 2. Type and source of Portland cement, fly ash, and slag
 - 17 3. Aggregate gradations
 - 18 4. Preformed expansion joint filler
 - 19 5. Field molded/poured sealant
 - 20 6. Dowel bars
 - 21 7. Expansion sleeves
 - 22 8. Tie bars
 - 23 9. Reinforcing steel bars
 - 24 10. Welded wire fabric
 - 25 11. Air entraining admixtures
 - 26 12. Water-reducing, set-retarding and set-accelerating admixtures (if used)
- 27
- 28 C. Test Reports: Submit field quality control test reports.
- 29
- 30
- 31

1.4 PROJECT CONDITIONS

- 32
- 33 A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.
- 34
- 35

PART 2 - PRODUCTS

2.1 MATERIALS

- 36
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- 39 A. Forms shall be of wood or metal and shall be straight and of sufficient strength to resist springing, tipping or other displacement during the process of depositing and consolidating the concrete. If of wood, forms shall be surfaced plank of at least 2-inch nominal thickness stock except for sharply curved sections; and if of metal, they shall be of approved section. The forms shall be of the full depth of the required curb or curb and gutter, driveway or sidewalk sections and shall be designed to permit secure fastening. Face boards, if used, shall be so constructed and shaped that their lower edge conforms to the lines and radius indicated by the cross section for the pertinent structure as shown on the plans. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. All forms shall be cleaned thoroughly and oiled before the concrete is placed against them.
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- 48 B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A185 and AASHTO M31 Grade 60. Furnish in flat sheets.
- 49
- 50 C. Reinforcing Steel: Deformed steel bars, ASTM A615, Grade 60.
- 51 D. Epoxy Coating: ASTM A775 where noted in the Drawings.
- 52 E. Portland Cement: Shall conform to ASTM C150, Type I unless Type III is specified.
- 53 F. Exterior Pavement Joint Materials:
 - 54 1. Preformed Expansion Joint Filler shall be 3/4 inch in thickness and shall conform to AASHTO M-213.
 - 55 2. Joint Back-up Material: Polyethylene foam, 100% closed cell.
 - 56 3. Sealant:
 - 57 a. Dow 888, by Dow Corning
 - 58 b. 301 NS by Pecora

- 1 c. Spectrum 800 or 900 by Tremco
- 2 G. Aggregate: ASTM C33.
- 3 H. Water: Clean and potable.
- 4 I. Dowel Bars: ASTM A615, Grade 60, and plain steel bars.
- 5 J. Air Entrainment:
 - 6 1. Air entrained concrete shall be used for all concrete construction. Slip formed concrete pavement shall
 - 7 contain 7.0% air, $\pm 1.5\%$. Other concrete shall contain 6.0% air, $\pm 1.5\%$.
 - 8 2. ASTM C260:
 - 9 a. Air-Mix or AEA-92, by Euclid Chemical Corp.
 - 10 b. MB-VR MB-AE 90, or Micro-Air, by BASF
 - 11 c. Daravair or Darex Series, by W.R. Grace
 - 12 d. Equivalent approved products
- 13 K. Liquid Membrane Curing and Sealing Compound: ASTM C1315, Type I, Class A or B, 25% minimum solids con-
- 14 tent, clear non-yellowing with no styrene-butadiene. Specifications for Liquid Membrane-Forming Compounds
- 15 for Curing Concrete, AASHTO M-148, Type 2 shall also apply if more stringent.
 - 16 1. Water Based, VOC less than 350 g/l:
 - 17 a. Super Aqua Cure, by Euclid Chemical Corp.
 - 18 b. Kure 1315 by BASF
 - 19 2. Solvent Based:
 - 20 a. Super Rez-Seal, by Euclid Chemical Corp.
 - 21 b. Kure-N-Seal 30 by BASF
- 22 L. Polyethylene Sheeting: Polyethylene sheeting for curing concrete shall conform to the requirements for white
- 23 opaque polyethylene film of the Specification for Sheet Materials for Curing Concrete, AASHTO M-171.
- 24 M. Synthetic Reinforcement: Novomesh 950 Marco synthetic fiber blend, or equivalent, complying with ASTM C
- 25 1116/C 1116M, Type III fiber reinforced concrete.

26 27 **2.2 CONCRETE MIXING**

- 28 A. Mix concrete and deliver in accordance with ASTM C94. Design mix shall produce normal weight concrete con-
- 29 sisting of Portland cement, supplementary cementitious materials, aggregates, admixtures and water to produce
- 30 the following:
 - 31 1. Compressive Strength: 3,500 psi minimum at 28 days unless otherwise indicated on the Drawings
 - 32 2. Slump Range: 2 to 4 inches for hand placed concrete, 1¼ to 3 inches for machine placed (slip-form) con-
 - 33 crete
- 34 B. Supplementary Cementitious Materials (SCM):
 - 35 1. Concrete mix shall contain SCM at the amounts specified unless other amounts are approved by the
 - 36 Owner's Civil Engineer. Either fly ash or ground granulated blast furnace slag (GGBFS) may be used for
 - 37 the SCM, but shall not be used together to form a ternary mix. Use of fly ash or GGBFS in the concrete
 - 38 mix is mandatory.
 - 39 2. Fly Ash:
 - 40 a. Substitute fly ash for Portland cement at 15 percent (15%) of the total cementitious content.
 - 41 ASTM C618, Class C.
 - 42 b. Use only one (1) type and source throughout project.
 - 43 3. Ground Granulated Blast Furnace Slag (GGBFS): Substitute GGBFS for Portland cement at 20% of the total
 - 44 cementitious content.
 - 45 a. If required to mitigate potential sulfate exposure or aggregate reactivity, up to 50 percent (50%)
 - 46 substitution of Portland cement is allowed.
 - 47 b. ASTM C989, Grade 100 or 120. Use only one (1) type and source throughout project.
 - 48 4. Maintain air-entrainment at specified levels.
- 49 C. Calcium chloride:
 - 50 1. Not allowed.

51 52 **PART 3 - EXECUTION**

53 54 **3.1 PREPARATION**

- 55 A. Begin paving work only after unsuitable areas have been corrected and are ready to receive paving.
- 56 B. Remove loose material from compacted base material surface to produce firm, smooth surface immediately
- 57 before placing concrete.

1 **3.2 INSTALLATION**

2 A. Form Construction:

- 3 1. Set forms to required grades and lines, rigidly braced and secured.
- 4 2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place minimum of 24 hours after concrete placement.
- 5
- 6 3. Check completed formwork for grade and alignment to following tolerances:
- 7 a. Top of forms not more than 1/8 inch in 10'-0"
- 8 b. Vertical face on longitudinal axis, not more than 1/4 inch in 10'-0"
- 9 4. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

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11 B. Reinforcement:

- 12 a. Fasten reinforcing bars or welded wire fabric (if required) accurately and securely in place with suitable supports and ties. Remove from reinforcement all dirt, oil, loose mill scale, rust, and other substances that will prevent proper bonding of the concrete to the reinforcement.
- 13
- 14 b. Incorporate synthetic fiber reinforcement into the concrete mix design, as recommended by the manufactures specifications and guidelines.

15

16

17 C. Concrete Placement:

- 18 1. Concrete shall be mixed and placed when the air temperature in the shade and away from artificial heat is a minimum of 35 degrees F (35°F) and rising.
- 19
- 20 2. Hot and cold weather concreting shall be in accordance with ACI 305R (hot weather) and 306.1 and 306R (cold weather). Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until set at required finish elevation and alignment.
- 21
- 22
- 23 3. Place concrete using methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
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- 26 4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint. Automatic machine may be used for curb and gutter placement. Machine placement shall be at required cross section, line, grade, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified herein.
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34 D. Joint Construction:

- 35 1. Contraction Joints: Construct concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, in uniform sections of length specified on Construction Drawings. Form joints between sections either by steel templates, 1/8 inch in thickness, of length equal to width of curb and gutter, and with depth which will penetrate at least 2 inches below surface of curb and gutter; or with ¾-inch thick performed expansion joint filler cut to exact cross section of curb and gutter; or by sawing to depth of at least ¼ of the poured thickness of concrete while concrete is between 4 and 24 hours old. If steel templates are used, they shall be left in place until concrete has set enough to hold its shape, but shall be removed while forms are still in place. Contraction joints in concrete curb and gutter shall be at a maximum spacing of 10-foot. Contraction joints in concrete sidewalk or pavement shall be at spaced at a length to width ratio not exceeding 1.5:1, with no dimension greater than 15 feet unless approved by the engineer.
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- 44
- 45
- 46 2. Longitudinal Construction Joints: Tie concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, to concrete pavement with ½-inch round deformed reinforcement bars of length and spacing shown on Construction Drawings.
- 47
- 48
- 49 3. Transverse Expansion Joints: Concrete curb, combination concrete curb and gutter, or concrete sidewalk shall have filler cut to exact cross section of curb, gutter, or sidewalk. Joints shall be similar to type of expansion joint used in adjacent pavement. Expansion joints to be located at high points, utility structures, curb returns, cold joints, or 100-foot maximum spacing.
- 50
- 51
- 52

53 E. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than ½ inch or more than 1 inch below finished surface where joint sealer is indicated. Furnish joint fillers in one piece lengths for full width being placed, wherever possible. Where more than one length is required, lace, or clip joint filler sections together.

54

55

56 F. Joint Sealants: Install in accordance with manufacturer's recommendations.

57

58 **3.3 CONCRETE FINISHING**

- 1 A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.
- 2
- 3
- 4
- 5 B. Work edges of sidewalks, gutters, back top edge of curb, and formed joints with edging tool, rounding edge to 1/2-inch radius. Eliminate tool marks on concrete surface. After completion of floating and troweling excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
- 6
- 7
- 8 1. Curbs, gutters, and sidewalks: Broom finish by drawing fine-hair broom across surface perpendicular to flow of traffic. Repeat operation as necessary to produce fine line texture.
- 9
- 10 2. Concrete Pavement: Broom finish by drawing medium-hair broom across surface parallel to direction of vehicle traffic. Repeat operation as necessary to produce even textured finish.
- 11
- 12 C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up minor honeycombed areas. Remove and replace areas or sections with major defects as directed by Developer.
- 13
- 14
- 15 D. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable work as directed by Developer.
- 16
- 17

18 **3.4 NIGHT CONCRETING**

- 19 A. Concreting operations shall be discontinued due to insufficient natural light, unless an adequate and approved artificial lighting system is provided and operated.
- 20
- 21

22 **3.5 CURING AND PROTECTION**

- 23 A. Protect and cure finished concrete paving using curing compound or with acceptable moist-curing methods in accordance with "water-curing" section of ACI 308. Cure for a period not less than seven days.
- 24
- 25 B. Use solvent based curing compound when compound is applied below 40 degrees F (40°F).
- 26

27 **3.6 BACKFILL**

- 28 A. After concrete has set sufficiently, spaces on either side of concrete pavements, by curb, combination concrete curb and gutter, or concrete sidewalk shall be refilled to required elevation with suitable material compacted in accordance with WisDOT Standard Specifications Section 02300.
- 29
- 30
- 31

32 **3.7 CLEANING AND PROTECTION**

- 33 A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- 34
- 35 B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.
- 36
- 37
- 38

39 **3.8 FIELD QUALITY CONTROL**

- 40 A. Field quality control shall be the responsibility of the Owner's Construction Representative in accordance with Division 1 and this section. Other field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements.
- 41
- 42
- 43
- 44

END OF SECTION

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**SECTION 32 17 23
PAVEMENT MARKINGS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Traffic line paint and thermoplastic material for traffic striping and marking.
- B. Application of traffic striping and control markings.

1.2 RELATED SECTIONS

- A. Asphalt pavement is specified in Section 32 12 16.13 - Plant-Mix Asphalt.
- B. Concrete pavement is specified in Section 32 16 00 - Concrete Pavement Curbs and Sidewalk.

1.3 MEASUREMENT AND PAYMENT

- A. Measurement: Pavement Markings will be measured for payment by the lump sum method, acceptably performed and completed.
- B. Payment: Pavement Markings will be paid for at the indicated Contract lump sum price, as indicated in the Bid Schedule of the Bid Form.

1.4 REFERENCES

- A. State of California, Department of Transportation (Caltrans), Standard Specifications, latest edition:
 - 1. Section 84: Traffic Stripes and Pavement Markings
- B. California Air Resources Board (CARB):
 - 1. Latest regulations governing permissible content of Volatile Organic Compounds (VOC) in paints

1.5 SUBMITTALS

- A. General: Refer to Section 01 33 23 - Submittals for submittal requirements and procedures.
- B. Shop Drawings: Submit drawings and diagrams, indicating stripe width of roadway divider stripes and parking stalls, configuration and dimensions of directional arrows, style and size of letters for "compact car" designation, configuration and dimensions of international handicapped symbol, and any other traffic control markings on pavement, such as "in" and "out" or "enter" and "exit" designations as indicated.
- C. Certificate of Compliance: Submit evidence or affidavit that certifies that paint to be used complies with latest CARB/VOC regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Type S or Type N traffic paint in accordance with AASHTO Designation M248. Regular set drying time.
- B. Waterborne Paint: Paints shall conform to FS TT-P-1952.
- C. Solvent Borne Paint: Paint shall conform to FS A-A-2886 or AASHTO M248. Paint shall be non-bleeding, quick drying, and alkyd petroleum base paint suitable for traffic bearing surface and be mixed in accordance with manufacturer's instructions before application for colors White, Yellow, Blue, and Red.
- D. Epoxy marking from the WisDOT approved products list and in accordance with Section 646.2.4.
- E. Glass Beads: AASHTO M 247, Type 1 or FS TT-B-1325, Type 1, Gradation A.

2.2 APPLICATION

- A. Apply no paint or thermoplastic material until pavement has cured for at least three (3) days or for the number of days as recommended by the manufacturer, whichever is longer. Ensure that pavement has cured sufficiently to carry application equipment without damage.
- B. Provide traffic striping and control markings on pavement, parking stalls, and curbs in accordance with the layout, configurations, and dimensions indicated on the Contract Drawings and approved Shop Drawings.
- C. Application equipment and procedures shall conform to the applicable requirements of the Caltrans Standard Specifications. Keep paint thoroughly mixed throughout application.
- D. Traffic control markings and parking stalls shall be applied with the use of substantial cutout patterns and templates, or with striping equipment that applies straight, uniform width, sharp lines. Coverage shall be thorough and complete in accordance with the paint and thermoplastic manufacturer's instructions and recommendations and the Caltrans Standard Specifications.

- 1 1. Provide three (3) coats for painted striping and pavement markings. Application rate per coat shall match
- 2 that specified in the Caltrans Standard Specifications for each coat of two coat system.
- 3 2. Apply thermoplastic material at a minimum thickness of 0.125 inch or at the manufacturer's
- 4 recommended minimum thickness, whichever is greater.
- 5 E. Traffic control markings and parking stalls shall be sharp and accurate, straight where required, without
- 6 fuzziness at edges of lines.
- 7 F. Accessible parking stalls shall include the International Symbol for Accessibility.
- 8 G. At completion, the Contractor shall check the work thoroughly and shall touchup traffic control markings and
- 9 parking stalls that are not distinct or thorough in coverage, or are not uniform in color.

10
11 **2.3 TOLERANCES AND APPEARANCE**

- 12 A. In addition to the tolerances and appearance requirements specified in the Caltrans Standard Specifications,
- 13 edges shall be uniform with local variations not exceeding 1/8 inch per foot and surfaces shall be smooth and
- 14 uniform.
- 15 B. Letter sizes and patterns shall be as indicated on the Contract Drawings with variations of not more than plus or
- 16 minus (\pm) 15% in dimension.

17
18 **PART 3 - EXECUTION**

19 Not Used

20
21 **END OF SECTION**

**SECTION 32 31 13
CHAIN LINK FENCING AND GATES (INTERIOR)**

PART 1- GENERAL		
1.1	CONDITIONS OF THE CONTRACT	1
1.2	SUMMARY	1
1.3	SUBMITTALS	1
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PART 2- PRODUCTS		
2.1	MANUFACTURERS	1
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PART 3- EXECUTION		
3.1	PREPARATION	2
3.2	INSTALLATION	2
3.3	CLEANING AND PROTECTION	2

PART 1 – GENERAL

1.1 CONDITIONS OF THE CONTRACT

- A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

- A. This Section includes the following items and includes a number of special conditions:
1. Standard galvanized fencing mounted into cored openings at concrete floor, minimum of 4' deep.
 2. Fencing as at the interior of the maintenance building.
 3. Posts, rails and bracing.
 4. Operable gates.
 5. Accessories and hardware.
- B. Refer to the drawings for layout. The layout may change or be adjusted prior to installation. Obtain approval for the Architect / Owner prior to proceeding with the work.
- C. Bollards are located at the corners of the fencing. Refer to section in division 5.

1.3 SUBMITTALS

- A. Product data including manufacturer's technical data, installation diagrams, specifications, and installation instructions.
- B. Shop drawings and layout showing elevations and details.
- C. Warranty information.

1.4 WARRANTY

- A. Provide manufacturer's 3-year warranty, covering parts and labor, including operators, controls, gate components and coating material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide fencing products by one of the following:
1. American Chain Link Fence Company
 2. Anchor Fence, Inc.
 3. Cyclone Fence Div./USX Corp.

2.2 MATERIALS:

- A. FABRIC:
1. Standard Steel Fabric: Comply with Chain Link Fence Manufacturers Institute (CLFMI) Product Manual. Furnish one-piece fabric widths for all fencing. Wire sizes to be 2-inch mesh, 11-gage (0.120-inch diameter) wire. Sharp edges shall not be exposed at any condition.
 2. Galvanized steel: ASTM A 392, Class 1 or 2. Provide coating on exposed components to match fabric.
- B. FRAMING
1. Strength requirements for posts and rails conforming to ASTM F 669.
 2. Pipe for posts: straight, true to section material, standard weight, type I pipe as follows:

- a. 3.0" OD (minimum) corner posts and gate location posts
- b. 3.0" OD at all other locations, except where noted.
- 3. Pipe fittings: Provide base plates and fittings with factory machined openings, screw fittings and sections for a complete installation.
- 4. Steel Framework, General: Rails, braces and frames of Type 1 pipe and C-sections as necessary, hot-dip galvanized.
- C. GATES:
 - 1. Rolling Gates:
 - a. Rolling gate and frame shall match fencing materials and finishes, reinforced as required for the conditions shown, with fully welded structural members for proper gate operation and structural stability/integrity. Rolling Gates shall have 4" clearance at grade, or above the curb line, whichever is higher. The gate shall be structurally designed to function properly within the parameters as shown on the drawings. Provide color-coated materials to match fencing for a complete installation, including the following:
 - i. Horizontal reinforcement: provide special wind stabilizer across the length of the gate.
 - ii. Rollers: Exterior-rated ball bearing rollers, supports, anchors, and accessories as required.
 - iii. Gate stops: Mushroom type w/flush plate and anchors.
 - iv. Cross bracing: Adjustable, diagonal cross bracing as recommended by the manufacturer.
 - v. Latch.
 - vi. Provide coating to match fabric.
 - vii. Refer to drawings for dimensions, clearances, and additional information.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Review the area or work, system components and operating conditions before proceeding with the installation. Ensure that all components are in hand and carefully assemble system using experience and manufacturer's assistance to ensure proper quality control.

3.2 INSTALLATION

- A. General: Install fence in compliance with ASTM F 567. Examine existing fencing and determine the best means of attachment and connection to the existing materials for a neat and consistent installation.
- B. Setting Posts, Rails and Bars: carefully plan and layout materials prior to installation to maintain a true and level installation. Install post and rails as required, or as shown on drawings, evenly spaced to accept fabric.
- C. Fabric: Leave approximately 2 inches between finish floor and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.
- D. Tension or Stretcher Bars: Thread through or clamp to fabric 4 inches once, and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches once
- E. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- F. Install gates per the manufacturer's instructions. Tests and adjust as necessary for a smooth and reliable operation.

3.3 CLEANING AND PROTECTION

- A. Upon completion, remove all unused or cut wire, pipe and accessories. Ensure that post holes have been filled and compacted with concrete to drain away from the standards. Cover and protect operator, push button station and other operational components until ready for use by the owner.
- B. Protect fencing from further construction activities until the entire work is complete.

END OF SECTION

**SECTION 32 91 19
TOPSOIL-SELECT FILL MATERIALS AND APPLICATION**

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section shall consist of providing all topsoil, labor, material and equipment required to complete the work described herein in strict accordance with the drawings and/or terms of the contract.
- B. All work on the public lands and/or public rights of way shall conform to the applicable City of Madison's Standard Construction Specifications stated below.
- C. All work shall be in accordance with applicable manufacturer's instructions.

1.2 RELATED WORK AND PROVISIONS

- A. Applicable provisions of Division 1 shall govern all work:
 - 1. Section 02 20 00 – General Sitework Requirements
 - 2. Section 31 20 00 – Earthmoving
 - 3. Section 31 25 00 – Erosion Control
 - 4. Section 32 92 19 – Seeding and Sodding

1.3 REFERENCES

- A. Where reference is made to the "Construction Specifications", it shall be construed to mean the pertinent section of the Village of Oregon's Standard Construction Specifications, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- B. Where reference is made to the "Standard Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- C. Where reference is made to the "State Specifications", it shall be construed to mean the pertinent section of the WisDOT Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- D. Where reference is made to the "Geotechnical Report", it shall be construed to mean the geotechnical report in Section 02 32 00.

1.4 QUALITY ASSURANCE

- A. Pre-Work Meeting: Convene a pre-work meeting minimum 30 days prior to commencing work on this Section. Review conditions of operations, procedures and coordination with related work. The pre-work meeting shall be set up as a conference call with the Landscape Architect.
 - 1. Review planting schedule and maintenance.
 - 2. Review required inspections, schedule of topsoil testing, and environmental procedures.
- B. Soil-Testing Laboratory Qualifications:
 - 1. Multi-residue Herbicide/Pesticide Screen: A NELAC (National Environmental Laboratory Accreditation Conference) certified independent soil testing laboratory with the experience and capability to conduct the testing indicated based on local conditions.
 - 2. Topsoil Analysis: Independent soil testing laboratory employing a landscape or soil agronomist familiar with the final use of the material and construction practices for large earthwork sites.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Select fill shall be a loamy sand, sandy loam, clay loam, loam, silt loam, sandy clay loam or other soil approved by the Owner's Construction Representative. It shall not have a mixture of subsoil and shall contain no slag, cinders, stones, lumps of soil, sticks, roots, trash or other extraneous materials larger than 1.5 inches in diameter. Select fill must also be free of viable plants or plant parts of common Bermuda grass, quack grass, Johnson grass, nutsedge, poison ivy, Canada thistle, or others as may be specified. All select fill shall be tested by a reputable laboratory for pH and soluble salts. If needed, pH correction material shall be applied at a rate sufficient to correct the pH to a range of 6.0 to 7.0. Soluble salts shall not be higher than 500 parts per million.

- 1 B. No turfgrass sod shall be placed on soil which has been chemically treated until sufficient time has elapsed to
- 2 permit dissipation of all toxic materials. The general contractor shall assume full responsibility for any loss or
- 3 damage to turfgrass sod arising from improper use of chemicals or due to his failure to allow sufficient time to
- 4 permit dissipation of toxic residues, whether or not such materials are specified herein.
- 5 C. Topsoil on the existing site may often be used; however, it should meet the same standards as set forth in these
- 6 specifications.
- 7 D. Refer to Drawings for specifications on Engineered Soils and Sand Storage Layers, as specified by Wisconsin
- 8 Department of Natural Resources (WDNR).
- 9

10 **PART 3 - EXECUTION**

11

12 **3.1 GRADING**

- 13 A. The select fill shall be uniformly distributed on the designated area(s) and it shall be a minimum of 6 inches deep
- 14 after firming.
- 15 B. No grading shall be done beyond the limits specified within the Grading and Erosion Control Plan.
- 16 C. Spreading shall be performed in such a manner that sod installation can proceed with a minimum of additional
- 17 soil preparation and tillage.
- 18 D. Any irregularities in the surface resulting from top-soiling or other operations shall be corrected in order to
- 19 prevent the formation of depressions or water pockets.
- 20 E. Select fill shall not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or in a
- 21 condition that may otherwise be detrimental to proper grading or proposed for seeding.
- 22

23 **3.2 CLEAN UP**

- 24 A. After the select fill has been spread and the final grade approved, it shall be cleared of all grade stakes, surface
- 25 trash or other objects that would hinder seeding and other plantings.
- 26 B. Paved areas over which hauling operations are conducted shall be kept clean and any soil which may be brought
- 27 upon the surfacing shall be promptly removed.
- 28 C. The wheels of all vehicles shall be kept clean to avoid tracking soil on the surfacing of roads, walks or other
- 29 paved areas.
- 30

31 **3.3 ACCEPTANCE**

- 32 A. Acceptance will be given by the Owner's Construction Representative, upon satisfactory completion of each
- 33 section or area(s), as indicated on the drawings or as otherwise specified.
- 34
- 35

END OF SECTION

**SECTION 32 92 00
TREES, SHRUBS, AND OTHER PLANTINGS**

PART 1 - GENERAL

1.1 SCOPE

- A. These specifications, along with contract drawings and lists of plant materials, apply to those items necessary for and incidental to the preparation, execution, completion and maintenance of the landscape planting activities (excluding lawn areas) specified in the contract. The scope includes the planting of trees, shrubs, perennials, and grasses, and the maintenance activities of fertilizing, pruning and watering.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.
B. Section 02 20 00 – General Sitework Requirements
C. Section 31 10 00 – Site Clearing
D. Section 31 20 00 – Earthmoving
E. Section 31 25 00 – Erosion Control
F. Section 32 91 19 – Topsoil-Select Fill Materials and Application
G. Section 32 92 19 – Seeding and Sodding

1.3 REFERENCE STANDARDS

- A. American Standards for Nursery Stock, ANSI Z60.1, current edition. American Association of Nurserymen, Inc.
B. Standardized Plant Names, Second Edition (1942). American Joint Committee on Horticulture Nomenclature, Horace McFarland Company, Harrisburg, PA.
C. American National Standard for Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance-Standard Practices, ANSI A300, current edition.
D. Where reference is made to the "Geotechnical Report", it shall be construed to mean the geotechnical report in Section 02 32 00.

1.4 QUALITY ASSURANCE

- A. All plant material shall conform to the American Standards for Nursery Stock, unless noted otherwise herein.
B. All plant material shall be true to the species and variety/hybrid/cultivar specified, and nursery-grown in accordance with good horticultural practices, and under climatic conditions similar to those of the site location. Specimens' nursery-dug to be replanted shall have been freshly dug and properly prepared for planting.
C. Trees and Shrubs:
1. Shall be trained in development and appearance as to be superior in form, compactness and symmetry. Trees with multiple leaders, unless specified otherwise, and shrubs with damaged or cut mainstem(s), will be rejected.
2. With a damaged, cut or crooked leader, abrasion of bark, sunscald, frost crack, disfiguring knots, insects (including eggs and larvae) or insect damage, cankers/cankeros lesions or fungal mats, mold, prematurely-opened buds, or cuts of limbs over 3/4 inches (1.9 cm) in diameter that are not completely callused will be rejected.
3. Shall have healthy, well-developed root systems, and be free from physical damage or other hindrances to healthy growth.
4. Balled and burlapped plants shall be dug with solid balls of a diameter not less than that recommended by the American Standards for Nursery Stock, and of sufficient depth to include both fibrous and feeding roots. Balls shall be securely wrapped with burlap, and tightly bound with rope or twine. No plant shall be bound with rope or wire in such manner as to damage bark or break branches. The root flare should be within the top 2 inches (5.1 cm) of the soil ball. Balled and burlapped plants will not be accepted if the ball is dry, cracked, or broken before or during planting.
5. Containerized plants are to be well-established within the container, with a root system sufficiently developed to retain its shape and hold together when removed from the container. Soil within the container should be held together by the roots, in form and whole. Plants shall not be pot-bound, nor have kinked, circling, or bent roots.
D. Herbaceous perennials and grasses shall only be supplied from nurseries certified by state plant inspectors.

1 **1.5 MEASUREMENT**

- 2 A. Plants shall conform to the measurements specified within the contract documents. Specified height and spread
3 dimensions will refer to the main body of the plant, and not from branch tip to branch tip. Plants meeting a
4 specified measurement, but judged to lack the balance between height and spread characteristic of the species
5 will be rejected.
6 B. Plants shall be measured when branches are in their normal position.
7 C. No plant shall be less than the minimum size specified, and no less than 50% of the plants shall be as large as the
8 maximum size specified.
9 D. Caliper measurements shall be taken 54 inches (1.4 m) above ground level
10 E. Containerized shrubs shall be measured by height and width for conformity with the plant list
11 F. Herbaceous perennials and grasses shall be measured by pot size, not by top growth
12 G. All other measurements, such as number of canes, ball sizes, and quality designations, shall conform to
13 American Standards for Nursery Stock.
14

15 **1.6 SUBSTITUTIONS**

- 16 A. The substitution of plant materials is not permitted unless authorized, in writing, by the Owner's Representative.
17 If written proof is submitted by the Contractor that a plant of specified species, variety or size is unavailable,
18 consideration will be given towards the nearest available size or variety, or towards an alternate species
19 selection, with a corresponding adjustment of the contract price.
20

21 **1.7 DELIVERY, STORAGE, AND HANDLING**

- 22 A. The Contractor is to arrange for the acceptance and unloading of plants at the project site.
23 B. All plants are to be labeled by plant name and size. Labels shall be attached securely to all plants, bundles, and
24 containers of plant materials when delivered. Labels shall be durable and legible, with information given in
25 weather-resistant ink or embossed process lettering. The Owner should verify all plant labels, upon approval the
26 plant labels shall be removed by the Contractor.
27 C. All plant materials, shipments and deliveries shall comply with current state and federal laws and regulations
28 governing the inspection, shipping, selling and handling of plant stock. If required by law or regulation, a
29 certificate of inspection, or a copy thereof, for injurious insects, plant diseases, and other plant pests shall
30 accompany each shipment or delivery of plant material. The certificate shall bear the name(s) and address(es) of
31 the source of the plant stock.
32 D. During transport, no plant shall be bound with rope or wire in a manner that damages trunks or breaks
33 branches. Plants shall also not be dragged, lifted or pulled by the trunk, branches or foliage in a damaging way.
34 No plant shall be thrown off of a truck or loader to the ground.
35 E. Prior to installation, all plants must be protected from sun and drying winds.
36 F. Containerized or balled and burlapped plants not being installed immediately must be kept in a shaded area,
37 well-covered with wood chips, soil, or other approved material, and kept well-watered. Install all plants within
38 three (3) days of delivery.
39 G. Fertilizer shall be delivered to the site in original, sealed containers, and stored in a waterproof space.
40 Containers shall bear the manufacturer's name, analysis, trademark and guarantee as per standards of the
41 Wisconsin Department of Agriculture.
42 H. Contractor shall protect all plants, lawns, and grass from damage at all times. Damaged plants, lawns or grass
43 areas shall be replaced or treated as required to conform to specifications herein for fresh stock. Damage
44 incurred as a result of replacement or installation operations shall be repaired by Contractor at no cost to
45 Owner.
46

47 **1.8 PLANTING SCHEDULE**

- 48 A. Plants shall be installed as appropriate for that specific plant species to ensure healthy vigorous growth.
49 B. All plants shall be guaranteed to be in healthy and flourishing condition for one full year after installation and
50 acceptance by the Owner.
51 C. Plants not thriving shall be replaced at no cost to the Owner. The contractor may suggest substitutions for
52 replacement plants.
53 D. Replacement plants shall be guaranteed for one year after installation.
54 E. At any time during the guarantee period, the Contractor shall remove or replace, without cost to the Owner and
55 within a specified planting period, all plants not in a healthy and flourish conditions as determined by the Owner.
56
57
58

1 **1.9 MAINTENANCE**

- 2 A. The Contractor shall maintain plantings and lawn for at least a period of 60 days, or until final acceptance from
3 the Owner. The Contractor is responsible for adequately watering plants and lawn during this 60 day period.
4 B. Fertilizing: Any and all chemical applications are to be performed in accordance with current federal, state and
5 local laws, through EPA-registered materials and application techniques, and performed under the supervision of
6 a licensed certified applicator. Apply fertilizer to planted areas at the specified rate, and as per manufacturer's
7 recommendations.
8 C. Watering: All plant materials installed under the contract shall be watered within the first 24 hours of initial
9 planting and not less than twice weekly until final acceptance by the Owner. Water used shall be of sufficient
10 quality for irrigation and free of materials harmful to plant growth.
11 D. Pesticide: Any use of pesticides during the contracted maintenance period, as determined by the Owner, shall
12 utilize the minimum amount of approved pesticide needed to control pests on plant materials installed under
13 the contract. Pesticide applications are to be performed in accordance with current federal, state and local laws,
14 through EPA-registered materials and application techniques, and performed under the supervision of a licensed
15 certified applicator. Apply at the specified rate, and as per manufacturer's recommendations.
16

17 **PART 2 - PRODUCTS**

18
19 **2.1 MATERIALS**

- 20 A. Plant Materials: A complete list of plant materials, including a schedule of quantities, sizes, and other
21 requirements, shall be included in the contract documents. If discrepancies occur between the printed plant list,
22 and the contract drawings, the printed list will take precedent.
23 B. Topsoil: Naturally fertile, agricultural soil, capable of sustaining vigorous growth, of uniform composition
24 throughout, without admixtures of subsoil, free of clay, stones larger than 1 inch (2.5 cm) in diameter, roots,
25 trash and debris of any kind, supplied by Contractor at his/her expense, and subject to approval by the Owner's
26 Construction Representative.
27 C. Planting Mixture: Material used in tamping around balls and roots during the planting operation shall be
28 prepared on site by mixing two (2) parts topsoil, one (1) part sand and one (1) part compost. All mixing shall be
29 done by mechanical means subject to the approval of the Owner's Construction Representative.
30 D. Fertilizer: Granular, non-burning product composed of not less than 50% organic slow-acting, guaranteed
31 analysis professional fertilizer. Commercial fertilizer shall conform to Wisconsin State Statutes, Section 94.64,
32 and meet the standards of the Wisconsin Department of Agriculture as to registration and labeling. Fertilizer
33 shall be specified in the contract documents as to composition, but is subject to revision to suit project site
34 conditions.
35 E. Shredded Hardwood Bark Mulch: Shredded hardwood bark mulch, free of material detrimental to healthy plant
36 growth. Mulch shall be finely shredded, weed free, dye-free mulch
37 F. Stone Mulch: Planted stone mulch areas shall follow the plan specifications and be spread to a minimum and
38 consistent depth of 3-inches. Stone mulch areas shall receive woven weed barrier fabric.
39

40 **PART 3 - EXECUTION**

41
42 **3.1 INSPECTION**

- 43 A. Topsoil: Refer to Topsoil-Select Fill Materials and Application Section specifications.
44 B. Verify that prepared soil base is ready to receive the work of this Section.
45 C. Beginning of installation means acceptance of existing site conditions.
46

47 **3.2 PREPARATION OF SUBSOIL**

- 48 A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make
49 changes in grade gradual. Blend slopes into level areas.
50 B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove any contaminated subsoil.
51 Plants can be removed through application of glyphosphate. Follow manufacturer's instructions for proper use.
52 C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment,
53 used for hauling and spreading topsoil, has compacted subsoil.
54

55 **3.3 PLACING TOPSOIL**

- 56 A. Refer to Topsoil-Select Fill Materials and Application Section specifications.
57 B. Spread any needed amendments per soil test and till soil to a depth of 3 to 4 inches. Ideal seed bed will be a
58 combination of soil particles ranging from approximately a quarter inch to a full inch in size.

- 1 C. Topsoil compaction should be below 250 psi, if topsoil compactions are greater soil should be ripped, disced, or
2 otherwise loosened to a depth of at least 12 inches.
3

4 **3.4 PREPARATION**

- 5 A. Stake all planting areas and notify Digger's Hotline (1-800-242-8511 statewide) to verify location of all
6 underground utilities prior to excavation.
7 B. Excavate planting areas as shown in included specifications.
8 C. Adequately barricade with proper warning devices any planting pit left open when planting work is not in
9 progress, and that poses a hazard to vehicles and/or pedestrians.
10 D. Maintain site housekeeping to provide for a safe and orderly project site. Collect and dispose of debris as they
11 accumulate.
12 E. The planting pit for containerized and balled and burlapped plants shall be at least 2.5 to 3 times the diameter of
13 the soil ball, or to a dimension otherwise specified.
14 F. The planting pit for a single shrub shall be 12 inches (30.5 cm) wider than the root ball.
15 G. Loosen the soil beyond the edge of the planting pit. The soil at the base of the planting pit is to remain
16 undisturbed, the depth of which shall correspond to the distance from the bottom of the soil ball to the root
17 flare, or slightly less.
18 H. Fence and/or box in all trees and plant material which are to remain at the drip line before work is started. Do
19 not permit heavy equipment or stockpiles within branch spread. Remove interfering branches without injury to
20 trunks, cover scars with tree paint.
21 I. For a shrub mass planting, the entire bed area is to be tilled to a depth of 4 to 6 inches (10.2 to 15.2 cm).
22 Excavate individual shrub pits to the proper depth.
23

24 **3.5 PLANTING OF TREES AND SHRUBS**

- 25 A. Remove plant containers by cutting or carefully inverting the container. For plants grown in plastic containers
26 slash the edges of the root ball from top to bottom with vertical 1-inch (2.5 cm) cuts using a sharp blade.
27 B. Root balled plants shall have rope, string, wire baskets, burlap and other wrapping material removed from the
28 top half of the ball after the plant has been set in the hole. Remaining wrappings, other than those made from
29 plastic or synthetic material, may be left around the bottom half of the ball.
30 C. Shrubs grown using root containment material shall have the containment bag removed prior to setting.
31 D. Set trees and shrubs straight and upright, and in the center of the planting hole and on the unexcavated base of
32 the planting pit, with the most desirable face towards the most prominent view.
33 E. Root-balled shrubs are to be carried and set in the hole by the root ball.
34 F. Backfilling: Backfill pits with excavated soil. No soil in frozen or muddy condition shall be used for backfilling.
35 G. When pit is approximately two-thirds backfilled, tamp down and water to eliminate air pockets. After initial
36 watering, add remainder of the soil to the top of pit, water without puddling, and firmly tamp without over-
37 compacting. Form a 2- to 3-inch (5.1 to 7.6 cm) high saucer around the outer rim of the pit prior to mulching.
38 H. All trees shall be installed with 5-foot diameter tree ring with 3-inch mulch layer. Tree rings shall have shovel
39 edging.
40 I. All parking islands shall receive a minimum of 18 inches of topsoil.
41

42 **3.6 PLANTING OF PERENNIALS, FORBS, AND GRASSES**

- 43 A. Preparation: Loosen soil of the planting bed to a depth of 4 to 6 inches (10.2 to 15.2 cm) by mechanical or hand
44 tilling while soil is dry. For bulbs, the depth of loosened soil will be determined by the type of bulb planted, and
45 specified in the contract or landscape plan.
46 B. After soil is loosened, till organic material into the soil across the planting bed to a uniform depth of 2 inches (5.1
47 cm) for peat moss or 1 inch (2.5 cm) for compost.
48 C. Fertilizer, at amounts determined by the soil test, shall be topdressed to the soil.
49 D. Apply approved mulch uniformly across the entire planting bed to a depth of 1 to 2 inches (2.5 to 5.1 cm).
50 E. Planting: Space as described in the landscape plan.
51 F. Unless otherwise specified, install plants no closer than 12 inches (30.5 cm) to the trunks of trees or shrubs
52 within planting bed, and to within 6 inches (15.2 cm) of the edge of the bed.
53 G. Prior to planting, biodegradable plant containers shall be split and non-biodegradable containers removed. The
54 root systems of all such plants shall be split or crumbled by hand.
55 H. All parking islands that contain perennials (not including bio-infiltration area) shall have a minimum of 18 inches
56 of topsoil. These areas shall also have 3 inches of mushroom compost spread uniformly over the parking island
57 and tilled into the top 6 inches of the soil.
58

- 1 **3.7 FINISHING**
- 2 A. Finish-grade planting areas to required elevations after plants have fully settled.
- 3 B. No soil is to cover the top of the root ball. All plants shall be completely mulched over the root system with a 3-
- 4 inch (7.6 cm) layer of specified mulching material immediately after planting. Pull back mulch no less than 3
- 5 inches (7.6 cm) and no more than 6 inches (15.2 cm) from the trunk.
- 6 C. Thoroughly water plants immediately after planting and before mulching, primarily within and filling the saucer.
- 7 D. Prune any dead or broken branches. Prune in accordance with NAA Guidelines conforming to the American
- 8 Standard for Tree Care Operations. Prune shrubs in accordance with standard horticultural practices. On cuts of
- 9 3/4 inches in diameter and bruises or scars on bark, trace the injured cambium layer back to living tissues and
- 10 remove. Smooth and shape wounds so as not to retain water and coat the treated area within approved
- 11 antiseptic tree paint.
- 12 E. Remove all twine and rope after planting, along with any labels attached around trunks or branches.

- 13
- 14 **3.8 CLEANING**
- 15 A. Dispose of excess soil. Remove all cuttings and waste materials.
- 16 B. Soil, branches, binding and wrapping material, rejected plants, or other debris resulting from plant installation
- 17 shall be promptly cleaned up and removed. New landscape construction in and around the planting areas are to
- 18 be especially well-cleaned.
- 19 C. Under no condition shall the accumulation of soil, branches or other debris be allowed upon a public property in
- 20 such a manner as to result in a public hazard. Likewise, under no circumstances shall any debris or incidental
- 21 materials be allowed upon adjacent private property.
- 22
- 23

END OF SECTION

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**SECTION 32 92 19
SEEDING AND SODDING**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Fertilizing.
- D. Seeding.
- E. Seed Protection.
- F. Mulching.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.
 - 1. Section 02 20 00 – General Site Work Requirements
 - 2. Section 31 10 00 – Site Clearing
 - 3. Section 31 13 16 – Tree Protection
 - 4. Section 31 20 00 – Earthmoving
 - 5. Section 31 25 00 – Erosion Control
 - 6. Section 32 91 19 – Topsoil-Select Fill Materials and Application

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Seed shall be delivered to the site in its original, unopened container, labeled as to weight, analysis, and manufacturer. Seed in damaged packaging is not acceptable. Store any seed delivered prior to use in a manner safe from damage from heat or any other deleterious weather conditions.
- B. Planting Season: The regular seeding season is considered April 1st through June 15th and September 1st through October 15th. If planting outside of regular seeding season, the Contractor is responsible for adequately watering the site to obtain vigorous healthy plant growth.

1.4 REFERENCE SPECIFICATIONS

- A. Where reference is made to the "Construction Specifications", it shall be construed to mean the pertinent section of the City of Madison's Standard Construction Specifications, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- B. Where reference is made to the "Standard Specifications", it shall be construed to mean the pertinent section of the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- C. Where reference is made to the "State Specifications", it shall be construed to mean the pertinent section of the WisDOT Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications, as they may pertain, except the method of measurement and basis of payment shall not apply.
- D. Where reference is made to the "Geotechnical Report", it shall be construed to mean the geotechnical report in Section 02 32 00.

1.5 GUARANTEE

- A. Guarantee plant material for a period of 12 months following the Substantial Completion Date in accordance with the Extended Maintenance/Warranty Chart included in Part 3 hereinafter.
 - 1. A limit of one replacement of each plant shall be required, except for losses or replacements due to failure to comply with requirements.
 - 2. Remove from site any plant that is dead or unsatisfactory to the Owner, or Landscape Architect. Replace plants during normal planting season.

1.6 SUBMITTALS

- A. Submittals shall be available at all times to the Owner.
- B. Grower/Nursery Information: Submit name, address, phone number and contact person for each Grower/Nursery 30 days prior to plant material selection meeting.

- 1 C. Materials Test Reports: Submit topsoil borrow area test reports to the Owner minimum six (6) weeks prior to
- 2 delivery to site.
- 3 1. Provide location of topsoil area tested.
- 4 2. Provide name of independent soil testing laboratory.
- 5 3. Provide date of sampling and testing.
- 6 D. Product Data:
- 7 1. Submit certification tags from sod and seed verifying type and purity to the Owner
- 8 E. Closeout Submittals:
- 9 1. Submit Meetings and Inspections Log prior to Final Completion of the Project.
- 10 2. Certification of Conformance: Provide certificate of satisfactory performance of planting operations
- 11 signed by the Contractor and Landscape Architect.
- 12

13 1.7 MAINTENANCE

- 14 A. The Contractor shall maintain lawn for at least a period of 60 days, or until final acceptance from the Owner.
- 15 The Contractor is responsible for adequately watering lawn during this 60-day period. Contractor is responsible
- 16 for establishing healthy vigorous lawn growth. Long-term maintenance is the responsibility of the Owner.
- 17

18 PART 2 - PRODUCTS

19 2.1 SEED MIXTURE

- 20 A. Grass Seed: All grass seed shall conform to the requirements of Wisconsin State Statutes, Chapter 94 (Seed
- 21 Law), and the Wisconsin Administrative Code Chapter ATCP 20, regarding noxious weed seed content and
- 22 labeling. Seed shall not be used later than one (1) year following the test date labeled.
- 23 B. Public Seed Mixture: Use State Specifications Mix 40 in the right-of-way.
- 24 C. Grounds Seed Mixture:
- 25 1. Use seed mixtures as specified on Drawings.
- 26 D. Detention Basin Seeding:
- 27 1. See drawings for plug plantings or native vegetative mat requirements.
- 28
- 29

30 2.2 SOIL MATERIALS

- 31 A. Topsoil: Refer to Section 32 91 19 - Topsoil-Select Fill Materials and Application.
- 32

33 2.3 SOD

- 34 A. Provide sod species suitable as lawn turf for the region. Sod shall be strongly rooted, weed, disease, pest free,
- 35 and uniform in thickness.
- 36

37 2.4 ACCESSORIES

- 38 A. Mulching Material:
- 39 1. Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped
- 40 cornstalks are not acceptable
- 41 2. Where necessary to maintain erosion control, seed shall be applied using Method B, Hydroseeding from
- 42 the State Specifications.
- 43 B. Fertilizer: Standard commercial packaged or bulk product in granular form conforming to the requirements of
- 44 Dane County and the Wisconsin Statutes and of the Wisconsin Administrative Code Chapter Agriculture 17.
- 45 Provide fertilizer meeting the following requirements: I don't know about the following, so I am going to delete
- 46 it.
- 47 C. Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.
- 48

49 PART 3 - EXECUTION

50 3.1 INSPECTION

- 51 A. Verify that prepared soil base is ready to receive the work of this Section.
- 52 B. Beginning of installation means acceptance of existing site conditions.
- 53
- 54

55 3.2 PREPARATION OF SUBSOIL

- 56 A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make
- 57 changes in grade gradual. Blend slopes into level areas.
- 58 B. No seeding shall occur on frozen ground or at temperatures lower than 32oF (0oC).

- 1 C. Remove foreign materials, weeds, and undesirable plants and their roots. Remove any contaminated subsoil.
- 2 Plants can be removed through application of glyphosate. Follow manufacturer’s instructions for proper use.
- 3 D. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment,
- 4 used for hauling and spreading topsoil, has compacted subsoil.
- 5 E. Unsuitable Subsoils: Locations containing unsuitable subsoil shall be treated by one or more of the following:
- 6 1. Where unsuitability is deemed by the Owner to be due to excessive compaction caused by heavy
- 7 equipment and where natural subsoil is other than AASHTO classification of A6 or A7, loosen such areas
- 8 with spikes, discing, or other means to loosen soil to condition acceptable to the Owner. Loosen soil to
- 9 minimum depth of 12 inches with additional loosening as required to obtain adequate drainage.
- 10 Contractor may introduce peat moss, sand, or organic matter into the subsoil to obtain adequate
- 11 drainage. Such remedial measures shall be considered as incidental, without additional cost to the
- 12 Owner.
- 13 2. Where unsuitability is deemed by the Owner to be due to presence of boards, mortar, concrete, or other
- 14 construction materials in sub grade and where natural subsoil is other than AASHTO classification of A6
- 15 or A7, remove debris and objectionable material. Such remedial measures shall be considered as
- 16 incidental, without additional cost to the Owner.
- 17 3. Where unsuitability is deemed by the Owner to be because natural subsoil falls into AASHTO
- 18 classification of A6 or A7 and contains moisture in excess of 30 percent, then installation of sub drainage
- 19 system or other means described elsewhere in Specifications shall be used. Where such conditions have
- 20 not been known or revealed prior to planting time and they have not been recognized in preparation of
- 21 the Drawings and Specifications, then the Owner shall issue pricing order to install proper remedial
- 22 measures.
- 23

24 **3.3 PLACING TOPSOIL**

- 25 A. Refer to Section 32 91 19 - Topsoil-Select Fill Materials and Application.
- 26 B. Spread any needed amendments per soil test and till soil to a depth of 3 to 4 inches. Ideal seed bed will be a
- 27 combination of soil particles ranging from approximately a quarter inch to a full inch in size.
- 28

29 **3.4 FERTILIZING**

- 30 A. Apply seed starter fertilizer at the rate specified by the product manufacturer.
- 31 B. Fertilizer must be phosphorus free and meet Dane County requirements.
- 32 C. Apply after smooth raking of topsoil.
- 33 D. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- 34 E. Mix thoroughly into upper 2 inches of topsoil.
- 35 F. Lightly water to aid the dissipation of fertilizer
- 36

37 **3.5 SEEDING**

- 38 A. Firm up soil with light irrigation—lightly dampen soil before seeding.
- 39 B. Sow seed using either Method A or Method B as defined in Section 630.3.3 of Standard Specifications for
- 40 Highway Construction.
- 41 C. Protect seeded slopes of 4:1 or greater against erosion with erosion control materials specified on grading and
- 42 erosion control plan.
- 43 D. Apply seed evenly in two directions at a rate specified by the product manufacturer. Rake in lightly. A
- 44 cultipacker or similar equipment shall be used to enhance soil/seed contact. Care shall be taken to avoid
- 45 damage to erosion mat in areas where erosion mat is specified. Do not seed areas in excess of that which can be
- 46 mulched on the same day.
- 47 E. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- 48 F. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
- 49 G. Do not use seed that is wet, moldy, or otherwise damaged in transit or storage.
- 50 H. Sow seed at a rate of 1½ pounds per 1,000 square feet. In addition to lawn seed, annual rye shall be applied to
- 51 all disturbed areas at a rate of 1½ pounds per 1,000 square feet.
- 52 I. Roll seeded area with 24-inch width roller not exceeding 112 pounds.
- 53 J. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches.
- 54 K. Apply water with a fine spray immediately after each area has been mulched keeping the top 1 to 2 inches of soil
- 55 moist but not soaking. Water adequately to achieve a healthy stand of weed free lawn. Do not let soil dry out.
- 56 L. Apply a second application of seed starter fertilizer at the rate specified by the product manufacturer 3 weeks
- 57 after seeding.

- 1 M. Begin weekly mowing when first seedlings reach 2 inches. Do not mow right after watering. Raise mowing
2 height to 3 inches after six (6) weeks. Never remove more than 1/3 of the grass blade at a time.
3 N. Begin standard fertilization and irrigation programs after eight (8) weeks. Do not apply any weed control
4 products until lawn has been mowed at least four (4) times and a minimum of eight (8) weeks have passed.
5 Follow manufacturer's recommendations for new lawns.
6

7 **3.6 SEED PROTECTION**

- 8 A. Identify seeded areas with stakes around area periphery. Refer to drawings for signage.
9

10 **3.7 SODDING**

- 11 A. Cut and lay sod on same day. Only healthy vigorous growing sod shall be laid.
12 B. Lay sod across slope and tightly together to result in solid coverage free of gaps.
13 C. Roll or firmly but lightly tamp new sod with suitable wooden or metal tamper sufficiently to set or press sod into
14 underlying soil.
15 D. All finished sodding shall be smooth and free of lumps and depressions.
16 E. After sodding has been completed, clean up and thoroughly water newly-sodded areas.
17

18 **3.8 MAINTENANCE DURING CONSTRUCTION**

- 19 A. Begin maintenance operations immediately after each plant is planted and continue as required until
20 acceptance. Water, mulch, weed, prune, spray, fertilize, cultivate, and otherwise maintain and protect plants.
21 Reset settled plants to proper grade and position, restore planting saucers, and remove dead, diseased, or
22 unhealthy plant material. Tighten and repair stakes and wires. Correct defective work as soon as possible after
23 it becomes apparent and weather and season permit.
24 B. Upon completion of the planting operations, clean up landscaped areas to be free of stones, containers, trash,
25 and other waste and debris to leave area in a neat and well-groomed appearance.
26 C. Supplement rainfall as required to provide an equivalent of 1 inch of water per week until the plants have rooted
27 and are established.
28 D. Make weekly inspections to determine moisture content of soil and adjust watering schedule established by
29 irrigation system installer to fit conditions.
30 E. After grass growth has started, reseed or sod areas that fail to show uniform stand of grass in accordance with
31 the Drawings and as specified herein. Continue reseeding and sodding such areas repeatedly until areas are
32 covered with satisfactory growth of grass. Perform removal and replacement or topsoil conditioning if required
33 to facilitate establishment of grass.
34 F. Water in such manner and as frequently as is deemed necessary by the Owner to assure continued growth of
35 healthy grass. Water areas of site in such a manner as to prevent erosion due to excessive quantities applied
36 over small areas and to avoid damage to finished surface due to watering equipment.
37 G. Provide water for execution and maintenance at no expense to the Owner. Furnish portable tanks, pumps, hose,
38 pipe, connections, nozzles, and any other equipment required to transport water from available outlets and
39 apply it to seeded areas in approved manner.
40 H. Mowing:
41 1. Initiate mowing of turf grass areas when grass has attained height of 3 inches and roots are firmly
42 established. Maintain turf grass height at 2½ to 3 inches at subsequent cuttings depending on time of
43 year. Remove no more than 1/3 of grass leaf at any cutting and cutting shall not occur more than ten
44 (10) days apart.
45 2. Mow native grass areas no more than three (3) times per year to a height of no less than 6 inches.
46 3. Remove heavy cuttings to prevent destruction of underlying turf. If weeds or other undesirable
47 vegetation threaten to smother planted species, such vegetation shall be mowed or, in case of rank
48 growths, shall be uprooted, raked, and removed from area by methods approved by the Owner.
49 I. Remove weeds and other undesirable vegetation by applying herbicides as recommended by the manufacturer
50 or by uprooting. Rake and remove uprooted vegetation from area by methods approved by the Owner.
51 J. Protect seeded area from pedestrian or vehicular trespassing while grass is germinating. Provide fences, signs,
52 barriers, or other necessary temporary protective devices. Repair damage resulting from trespass, erosion,
53 washout, settlement, or other causes.
54 K. Remove fences, signs, barriers, or other temporary protective devices after final acceptance.
55 L. Grassed areas damaged during process of work shall be restored or repaired to condition satisfactory to the
56 Owner. Fill, grade, re-fertilize, replant, or mulch as required to restore to contract requirements.
57
58

END OF SECTION

**SECTION 41 21 00
MATERIAL HANDLING EQUIPMENT (OVERHEAD CRANE SYSTEM)**

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes a 2-ton bridge crane system and VFD trolley.
- B. Crane is attached to the steel beam and associated supports: verify and coordinate attachment with the steel supplier. Coordination and verification of attachment to the steel is a key component of the work.
- C. Refer to the drawings for the range/area of coverage for the bridge crane, with the dashed line indicating hook coverage.

1.2 RELATED WORK

- A. Refer to the following sections:
 - 1. Division 5.
 - 2. Electrical Division 26.

1.3 SUBMITTALS

- A. General: Submit listed submittals in accordance with Contract Conditions and submittals section.
- B. Product Data: Submit specified products as follows:
 - 1. Manufacturer's product data, including manufacturer's technical data sheet.
 - 2. Manufacturer's installation instructions.
 - 3. Shop drawings.

1.4 CLOSEOUT SUBMITTALS

- A. General: Submit listed submittals in accordance with Contract Conditions and submittals section.
- B. Operation and Maintenance Data:
 - 1. Submit operation and maintenance data for installed product as follows:
 - a. Manufacturer's instructions detailing maintenance requirements.
 - b. Parts catalog showing complete list of available parts.
 - c. Replacement parts with cuts and identifying numbers.
- C. Load test results.
- D. Warranty Documentation: Submit warranty documents specified.

1.5 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Minimum of 10 years of experience manufacturing components similar to or exceeding requirements of project.

- b. Having sufficient capacity to produce and deliver required materials without causing delay in work.
 - c. Capable of providing field service representation during construction.
2. Installer: Acceptable to manufacturer.
3. The work shall conform to the following standards. In each case refer to the most current standard or reference:
 - a. ANSI-ASME HST-1M, Performance Standard for Electrical Chain Hoists.
 - b. ANSI-ASME B30.16, Safety Standard for Overhead Hoists.
 - c. ANSI M27.1, Specification for Underhung Cranes and Monorail Systems.
 - d. ANSI-ASME B30.11, Safety Standard for Underhung Cranes and Monorail Systems.
 - e. ANSI/NFPA 70, National Electrical Code
 - f. Federal and State OSHA requirements.

1.6 DELIVERY, STORAGE & HANDLING

- A. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.
- B. Storage and Handling Requirements:
 1. Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.
- C. Packaging Waste Management:
 1. Remove packaging materials from site and dispose of at appropriate recycling facilities.
 2. Fold metal and plastic banding. Flatten and place in designated area for recycling.
 3. Remove all unused materials.

1.7 WARRANTY

- A. Warranty: Supplier shall provide special two (2) year warranty, signed by Contractor and Supplier, agreeing to replace/ repair/restore defective materials and workmanship of cranes and hoists during warranty period. "Defective" is hereby defined to include, but not by way of limitation, operation or control system failures, performances below required minimums, excessive wear, unusual deterioration or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, failure of controls and similar unusual, unexpected and unsatisfactory conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide from one of the following:
 1. Manufacturer of Crane and Rail Systems: Subject to compliance with all specified requirements, provide products the following:
 - a. Cleveland.
 - b. Louden (Acco).
 - c. TC/American
 2. Manufacturer of 2-Ton Hoist: Subject to compliance with requirements, provide products of one of the following, as applicable to type:
 - a. Acco-Wright
 - b. Coffing
 - c. Detroit Hoist
 - d. Yale
 - e. Approved equal chain type.

2.2 MATERIALS / SYSTEM

- A. Crane, General: Except as otherwise indicated, provide manufacturer's standard single girder, motor driven crane which operates on 3.33" flange patented track, designed for "C" class service (ANSI Standard). The crane area of coverage is shown on the drawings.
 1. Bridge crane: 2-ton capacity.
 2. Bridge Crane Electrification Systems: Enclosed rigid track flat cable festoon systems for both power and control, and for independent "walk-away" push button pendant.

3. Motor Drive: Dual pair of motors at each rail, with manufacturer's high torque motor. All components of the motor shall be highest quality available. Provide crane with VFD (variable frequency drive) unit.
 4. Brake: Manufacturer's standard AC disc brake.
 5. Gear Drive: Helical type cut from solid blanks (AGMA spec), supported at both ends by tapered roller bearings, and enclosed in oil tight housing with oil bath.
 6. Bridge Girder: Provide same material as used with runway track. Deflection shall be limited to 1/450th of the span.
 7. End Trucks: Dual motor drive and two sets of forged wheels. Wheels shall be a minimum of 4-1/2" in diameter.
 8. Paint: Prime all steel with manufacturer's standard primer/finish coat of yellow, lead-free alkyd enamel.
- B. Runway Systems, General: Provide patented monorail track that is designed with a minimum safety factor of five (5), based on the ultimate strength of the material.
1. Runway shall be supported off of structural joist members as shown on the drawings. Crane supplier shall verify and coordinate loading condition with joist supplier.
 2. Track: Provide one pair of rails for crane specially designed as a runway for trolley assembly. Provide special patented track system with a steel rail, rolled or fabricated, with bottom flange shall be 3.33" wide. Minimum carbon content of 0.55, a minimum manganese content of 0.60, a minimum ultimate tensile strength of 115,000 psi and a minimum yield point stress of 63,000 psi. Deflection shall be limited to 1/450th of the span. Runway shall be adequately braced after leveling system.
 3. Stops: Provide universal or intermediate stops at ends of runways as required including all hex head cap screws, nuts and washers.
 4. Hanger Assemblies: Provide adjustable beam clamp, cleat and rod assemblies including all hex head cap screws, nuts and hardened bearing washers. Provide for horizontal and vertical adjustment. Assemblies shall be designed for 5 times the anticipated point loads, without any bending stress.
 5. Runway shall be supported off of structural joist members as shown on the drawings. Crane supplier shall verify and coordinate loading condition with joist supplier.
- C. Electrification Systems: Provide rigid enclosed safety type, 4 conductor, UL approved, maximum 90 amp rating, complete with all mounting hardware. Design and verify electrical system components @ 460/480 3 phase - 60 hertz. Coordinate electrical connection with electrical contractor.
- D. Hoists, General: Except as otherwise indicated, provide manufacturer's standard chain hoist with all components including gear drive, brakes, limit switches, motor, controls, frame, housing, hook, chain and all necessary accessories for complete operation. Equip with both a direct acting disc-type motor brake and a mechanical load brake. Provide alloy-steel couplings with splined shafts and geared limit switch. Mechanical slip clutch shall prevent lifting loads at 125% of design capacity.
1. Provide chain type hoist with variable lifting speeds.
 2. Motorized trolley shall have a variable frequency drive (VFD).
 3. Paint: Provide standard factory primed/painted white/red or manufacturer's standard color system.
- E. Controls: Provide manufacturer's cordless / wireless held controls to operate and stop the crane and hoist.
- F. Accessories: Provide all accessories for a complete system for the intended purpose of use. Provide all special and standard equipment and accessories to satisfy safety requirements listed under "Quality Assurance".
- G. Performance Specification: Within the limits of use shown on the drawings, the user of the crane/hoist system shall be able to fully control the lifting, moving and placing of goods. within the limits specified, with ease and comfort. Operator/user shall be able to easily control the movement of goods or the lifting of heavy equipment, after training by crane/hoist supplier, within the limits specified under the manufacturer's literature.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that conditions of conditions, including the structural deck, previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to vehicle lift installation.
1. Inform Architect of unacceptable conditions immediately upon discovery.
 2. Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- A. Coordinate the plates and connections with the structural precast supplier during shop drawings phase and in the field.

3.3 INSTALLATION / SET-UP

- A. Uncrate and assemble all parts and components necessary for operation. Examine and operate all system components to ensure complete and safe operation.
- B. Install hoists and accessories per the manufacturer's instructions. Replace any defective parts and immediately repair and defective elements that are easily repairable, with no impact on the safety, performance, warranty or operation of the systems.
- C. In a professional manner, repaint any areas of the cranes or hoists that have be damaged during installation.
- D. Field lubricate items or assemblies that require lubrication.
- E. Accurately fit, align, securely fasten and install free from distortion or defects.

3.4 ADJUSTING

- A. Adjust components and systems for correct function and operation in accordance with manufacturer's written instructions.
- B. Lubricate moving parts to operate smoothly and fit accurately.

3.5 CLEANING

- A. Upon completion, remove surplus materials, rubbish, tools and equipment.

3.6 CLOSEOUT ACTIVITIES

- A. Under the direction of the manufacturer's representative, and in the presence of the Owner's representatives and Architect, perform a series of field / load tests to the satisfaction of all parties.
- B. Operating Tests: Load each crane and hoist to 110% of its capacity and operate continuously for 10 minutes over its full travel distance, stopping at intervals and proceeding immediately to the next. Record failures of any parts or assemblies.
- C. Two weeks prior to tests, submit a list of test procedures for lifting, moving and operating all hoists and trolleys, loaded and unloaded.
- D. Demonstration: Coordinate requirements for vehicle lift demonstration with the Owner.
- E. Training: Coordinate training with the Owner in order to meet their schedule. Advise in advance the time necessary to complete this task. Instruct Owner on the adjustment and operation of vehicle lifts.

3.7 PROTECTION

- A. Protect installed product from damage.
- B. Repair damage to adjacent materials caused by vehicle lift installation.

END OF SECTION